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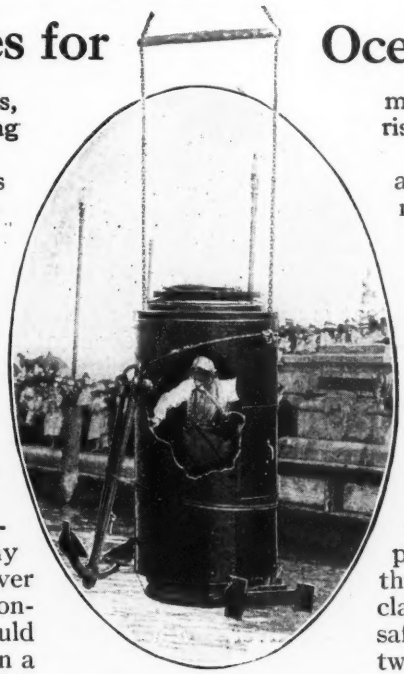
Floating Safes for Ocean Liners

When the ship sinks, the safes, containing mail and valuables, rise to the surface

EVERY ship that goes down is to some extent a treasure ship. Her purser is in charge of much money, and her passengers carry valuables. Fortunes have been lost in trying to raise sunken treasure, but not until Menotte Nanni appeared on the scene did any one think of preventing the treasure from sinking, whatever happened to the ship. Why bother about ways to recover sunken treasure when a non-sinkable purser's safe would prevent the sinking? When a steamer passenger sees his jewelry stored away in the ship's safe he doesn't know whether it is going to a salt water grave or not.



The inventor in his floating safe, on his way to the bottom of Lake Michigan in a test

Inspired by the knowledge of the lack of preventative measures of this kind, Menotti Nanni has devised a non-sinkable vault which is not only large enough to hold the purser's safe, but which also provides ample storage space for registered mail, gold bullion, and valuables owned by the passengers.

Nanni plans to install several of his floating safes in a large, vertical cylindrical steel casing placed in a well amidships, the top of the well being flush with the upper deck and covered with a loose-fitting, easily-removed cap. The safes are placed one on top of another, the first, second and third class passengers each having a safe for their valuables. The two lower safes serve as a repository for registered mail and for the most precious part of the ship's cargo.

Testing the fire resisting qualities of the safes. The boat was set on fire, after which it sank. The vaults floated to safety

Ready access is gained to the safes through doors provided in both the outer and inner casings at the various decks. Thus the first class passengers, for instance, could place their valuables in the safe at night and remove them in the morning. Of course there

would be a guard in charge of each safe.

If a ship equipped with such a system of floating safes should sink, the cover of the well would float off, the water would enter the steel casing and force the safes to rise to the surface. Once on the surface the safes bob about, to be eventually picked up by a passing craft. The inventor has also provided for hermetically-sealed floats to be placed at the extreme bottom of the well under the last safe. Attached to this float is a cable which serves to indicate the position and identity of the ship.

Ship in the act of sinking, showing two of the safes which have floated immediately to the surface

It is said that the value of cargos annually lost on the British coast in time of peace is $45,000,000. Of course the loss has increased with the war. The *Merida*, sunk in collision with the Admiral Farragut, in 1911, sixty-five miles east of Cape Charles, in three hundred feet of water, had about $200,000 in valuables in the purser's safe. The *Oceana*, sunk off Beachy Head, in 1912, had on board $5,000,000 in gold and silver. The *Lusitania* had about $1,000,000 in gold and jewelry and several millions in securities aboard. The *Islander*, sunk near Juneau, Alaska, had $2,000,000 worth of Klondike gold aboard. The *Pawabiac*, sunk in Lake Huron, had $800,000 in treasure. The *General Grant*, wrecked on the Auckland Islands, in 1866, in eighty feet of water, carried $15,000,000 in gold bars and bullion. The flagship *Florentia*, lost in Tobermory Bay off the west coast of Scotland, also carried $15,000,000.

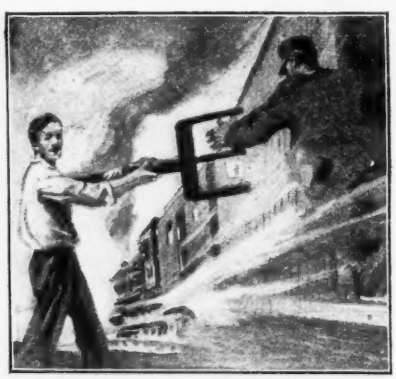
Then, remember the fleet of seventeen Spanish galleons with an accumulated treasure of $140,000,000, which was sunk in Vigo Bay, Spain. Six of the galleons, being in shallow water, were later raised, and about $20,000,000 recovered. But the others, containing $120,000,000, still rest at the bottom of Vigo Bay.

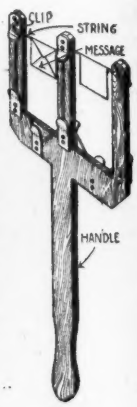
Delivering Orders to Conductors and Engineers on Speeding Trains

A DEVICE for delivering messages and orders to trainmen when the train is traveling at full speed has been invented by Edward Y. O'Connor and Carl N. McCaslin of Earl Park, Indiana. The station master simply places the messages in the device and holds it so that the conductor and engineer can catch them as the train rushes by. This is an improvement over present methods, since it eliminates a stop at each station where orders are to be given.

The device is of wood and consists of three forks with clips or leaf springs attached to them. These clips serve as fastening points for the cord upon which the messages are hung. The cord is thus held firmly in place.

Two messages can be delivered at the same time, one to the engineer and the other to the conductor, by holding the device so that the engineer may snatch his message and then reversing the position so the conductor may get his.





The device is of wood and consists of three forks with clips on which the message is hung

The editor of the POPULAR SCIENCE MONTHLY wants to hear from readers who have interesting photographs and interesting articles to sell. New inventions, natural curiosities, queer ways of using old devices—all these make good pictures. Accepted contributions are paid for promptly and liberally. But readers must understand that only unpublished contributions offered exclusively to the POPULAR SCIENCE MONTHLY are desired.

© Underwood and Underwood

Bridgeport school children going through a tooth-brush drill. Thousands of school children and adults in other cities are now given a regular drill in the care of their teeth

The Tooth-Brush Drill Has Become a Part of the School Course

DECAYED teeth are causing more harm to the human race than alcohol. Dr. Alfred C. Fones, of Bridgeport, Conn., says that approximately ninety-five millions of persons in the United States have decayed teeth. Dentistry's next great step, in his opinion, is to wipe out or prevent tooth decay by a systematic campaign of education on the care of the teeth among school children.

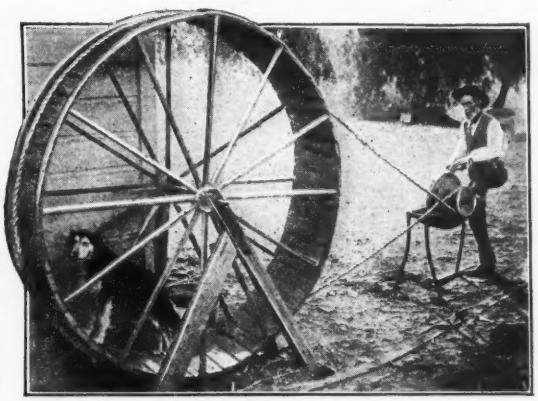
How shall this be done? Bridgeport's plan has attracted wide attention already. Every child in that city submits to a thorough examination of the mouth and is given free treatment. This type of clinic costs about eighty cents per child per year. The city assumes one half the responsibility in educating and helping the children to preserve their teeth. The other half, which is placed on the child and its parents, consists in providing proper food and in caring for the mouth.

Decayed teeth are due to the action of acids on the teeth, followed by the work of micro-organisms flourishing in the remains of food. To combat decay the surface of the teeth must be kept absolutely clean and free from deposits and accretions.

Operating a Scissors Sharpener by Dog-Power

THE itinerant tradesman, umbrella mender and scissors sharpener are familiar figures in the suburbs and on the outskirts of large cities, where they break the silence and the monotony of the hours with their horns. But in the rural districts the companion of such vendors is usually a dog of nondescript type.

That the dog may be made a useful member of the firm has been proven by a man who travels through Carpenteria, Cal., soliciting scissors-grinding trade. He has a machine for the work and the dog has been taught to furnish the power for it. This he does right merrily. He gets on the wheel of his own accord and treads away with vigor, while his master sharpens scissors and knives. To all appearances the dog thinks it is a game devised for his amusement; but the owner believes that a sense of responsibility and a desire to do a full share of the work of the day is stronger than the play spirit in his companion.



The scissors-grinding machine run by dog power. Nothing less than a full day's work with a half hour's sleep at noon satisfies Rover

When business is slack the animal will run to his wheel and bark reproachfully at his master until the man feels obliged to attach the rope which turns the grinder.

Chin Chin, the Elephant, Gets Her Winter Shoes

Chin Chin walking down a plank wearing her stylish boots. The elephant suffered from cold feet and was taken to a Boston shoe shop where she was fitted with the only made-to-order elephant shoes known. The material alone used in making the shoes cost forty dollars

Standing on her head in order to allow her hind feet to be measured. Chin Chin was a patient customer, even when she was required to take this unusual position. Her shoes were made of a plump piece of upper stock, a blue collar, a juniper sole and a wool skin inner sole. She seemed very well pleased with their fit and appearance

Photos by New York Hippodrome

Taking her foot measurement with fitting stick and tape. According to the shoe man Chin Chin's size was a full sixteen on the stick and X Y Z wide —all in feet and inches. She is shown here asking the shoe man whether he thinks she ought to wear arch supports or not

A Mountain of Tea for the Fighting Tommy

© Int. Film Serv.

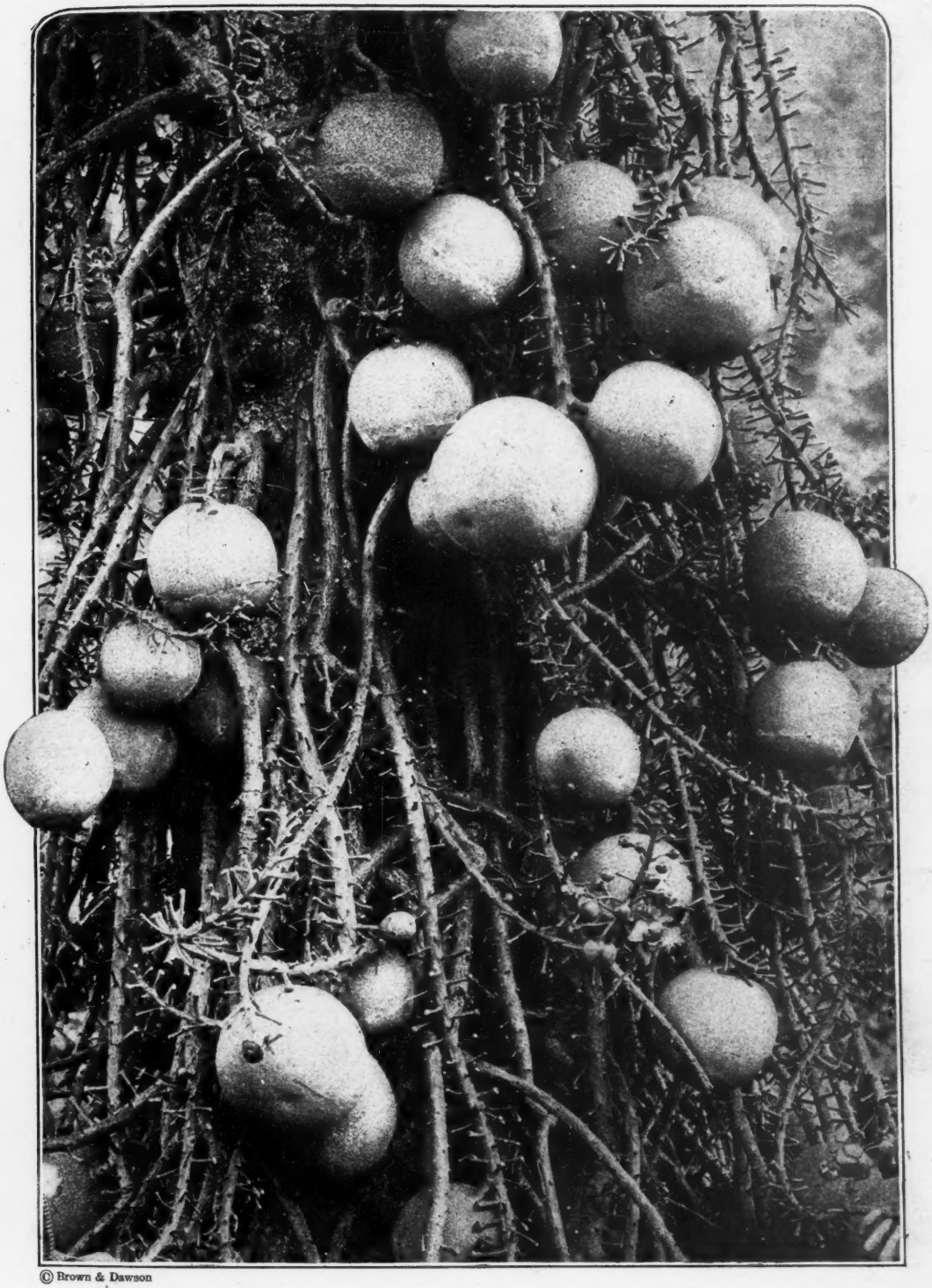
A mountain of tea, containing forty-eight thousand pounds, which is being blended, packed and dispatched to the British soldiers at the front. The men are using wooden spades to shovel the tea from the pile in the foreground to the big conical heap. Although their five-o'clock tea is not always unmolested. the English soldiers enjoy it as much in the trenches as they do at home

The Ganges Swallows the Ashes of India's Dead

© Newman Travelalks and Brown and Dawson

A burning ghat along India's famous Ganges, showing bodies being burned and one waiting its turn. After the bodies have been burned on the pyres shown in the photograph the ashes are thrown into the river. The steps, on which the dejected relatives squat and where sight-seers gather, lead up to a temple where the burial rites were performed. The men working in the water are dipping up mud, which lies on the bottom and burns like charcoal. This they dry and sell for a mere pittance. Piles of it can be seen at the left of the picture

They Grow Cannon Balls on Trees in South America

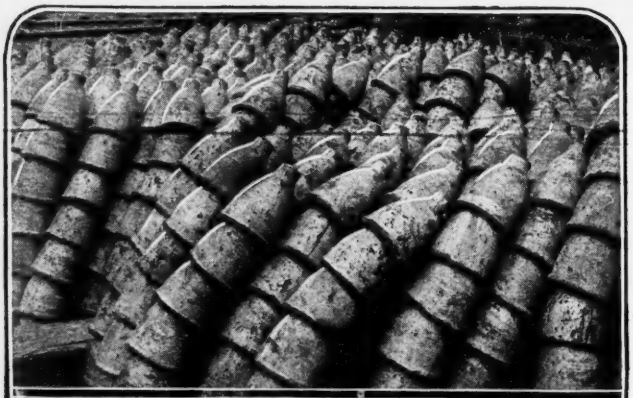


© Brown & Dawson

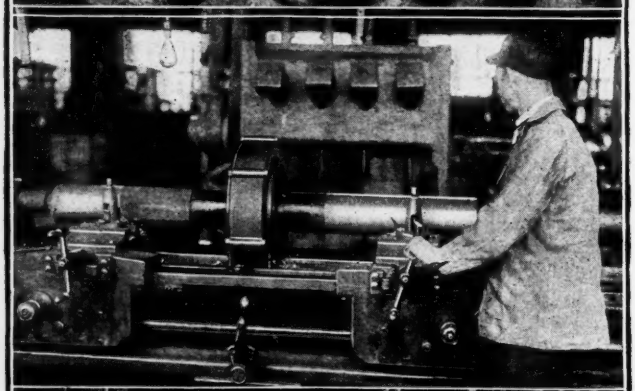
The Cannon-Ball tree (Couroupita guianensis) is a native of tropical South America. It bears large, spherical, woody fruits containing many seeds. In French Guiana the tree grows in great profusion, the natives referring to it as the "baseball tree." When full grown the fruit is a little larger than a baseball which it closely resembles even to the seam, which is quite plain in the photograph The fruit is not used for food by the natives

Making Shells for Europe—America's New

At right: Steel point castings, "nose pieces," as they are received at the ammunition plant. A shell is composed of two pieces, the nose piece or point, and the body piece. The nose of the finished shell can be unscrewed from the body



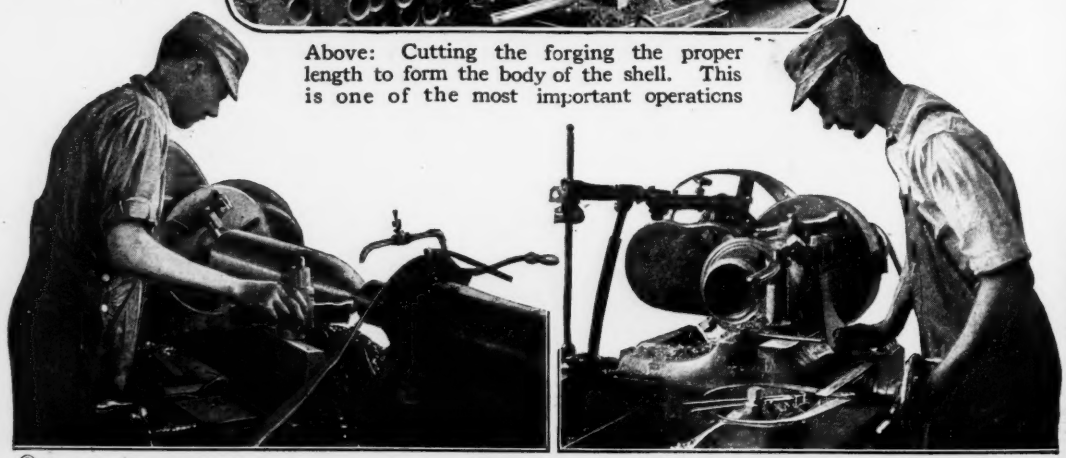
At left below: A twin machine that automatically turns two shell bodies at the same time to the right diameter. The shells being made are six-inch high explosive shells, used in the smaller naval guns and in field pieces



Below: Truing up a six-inch shell after the body and point have been fitted together. This is careful work as the Allies are most critical and throw aside any shell which does not measure up to within one-two thousandth of an inch

Below: Shaping the nose piece to fit the body of the shell. Note the measuring instruments at the worker's left. These are constantly used to guide him in making the nose piece absolutely accurate. The machine is of American make

Above: Cutting the forging the proper length to form the body of the shell. This is one of the most important operations



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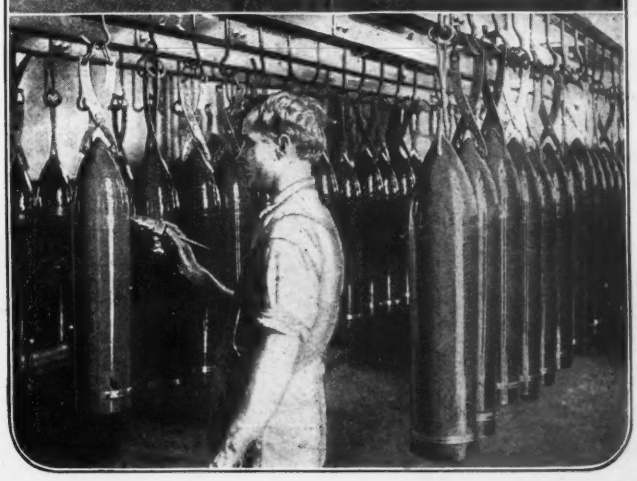
Industry Which Keeps the Big Guns Barking

At right: Boring out the interior of a shell body to make the thickness of the body the proper dimension. Many different sizes are made, varying from one and four-tenths to sixteen inches, but the medium sizes are in greatest demand

At right below: A pile of rough forgings from which the six-inch shells are made. The shells shown here would last but a few minutes in one of those fierce offensives that were daily occurrences in the early autumn fighting and before Verdun

At right below: After inspection each shell is given two coats of yellow enamel paint to prevent rust in transit. The shells are hanging by holes drilled in the nose piece. When ready to load, the nose is unscrewed with the aid of these holes



Below: Testing the fitting of nose piece to the shell body. The rings shown on two of the shell bodies are for checking the outside dimension of the shells and the gage-stick shown in the third is used to get the depth of the bore

Photos Press Illustrating Serv.

Temporary Vaults at Panama for the Chinese Dead

© Brown and Dawson

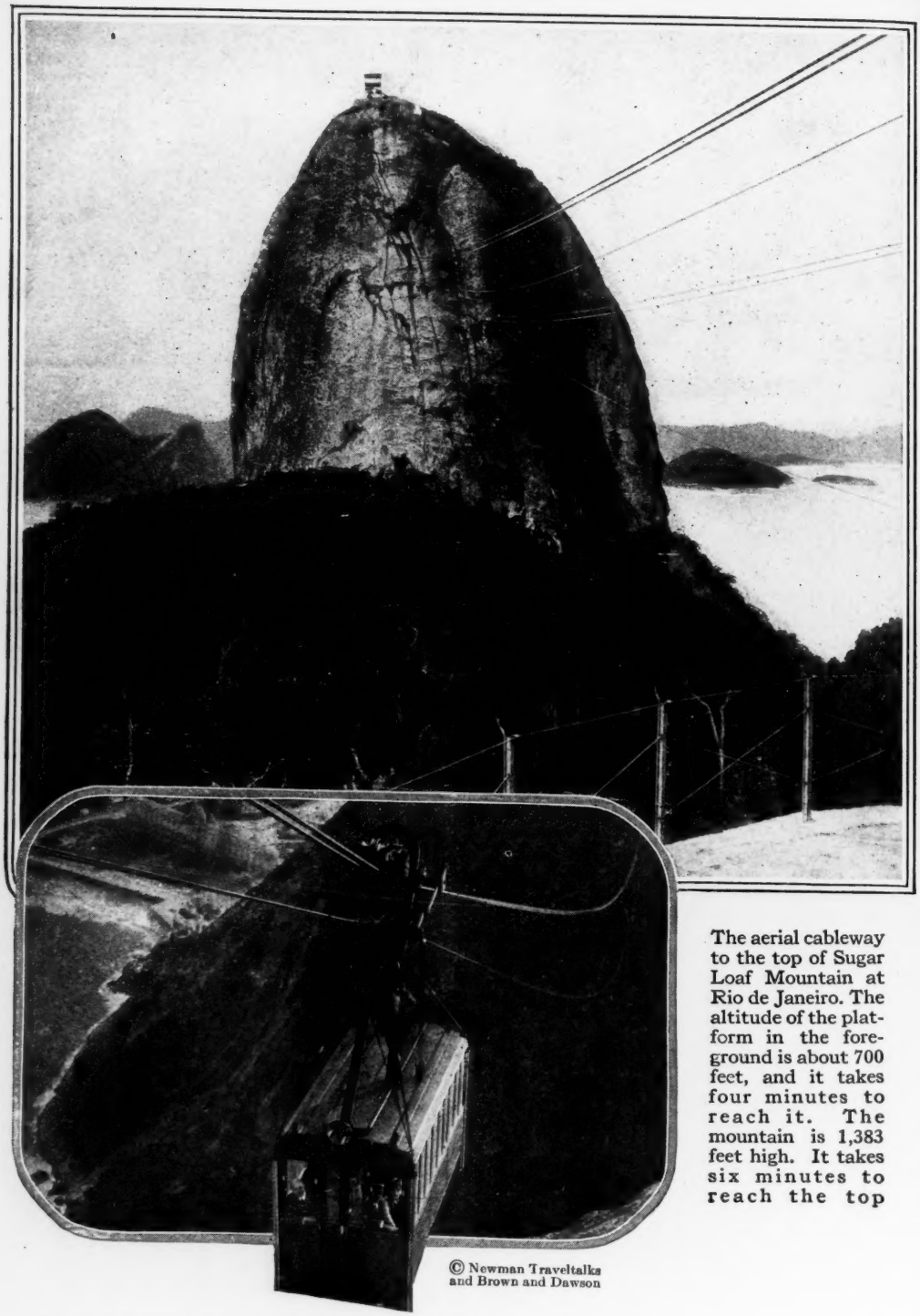
Every Chinaman wants to be buried in his native land. As the shipping of each separate body is an expensive undertaking the Chinese have erected this vault to store the dead at Panama until a sufficient number of bodies have been collected to make one large shipment

A Modern Titan Among the Derricks

Photo Underwood and Underwood

The great derrick "Hercules" lifting a steel mast into position on an unfinished battleship. The "Hercules" is one of the largest electrically-operated and revolving derricks in the world. In spite of its great mass it can be handled by one man. America is enjoying an unprecedented ship-building boom. There are now under contract to be completed in two years vessels to contain a million and a half tons of steel and five thousand tons of wood

A Trip to Rio's Sugar Loaf Mountain

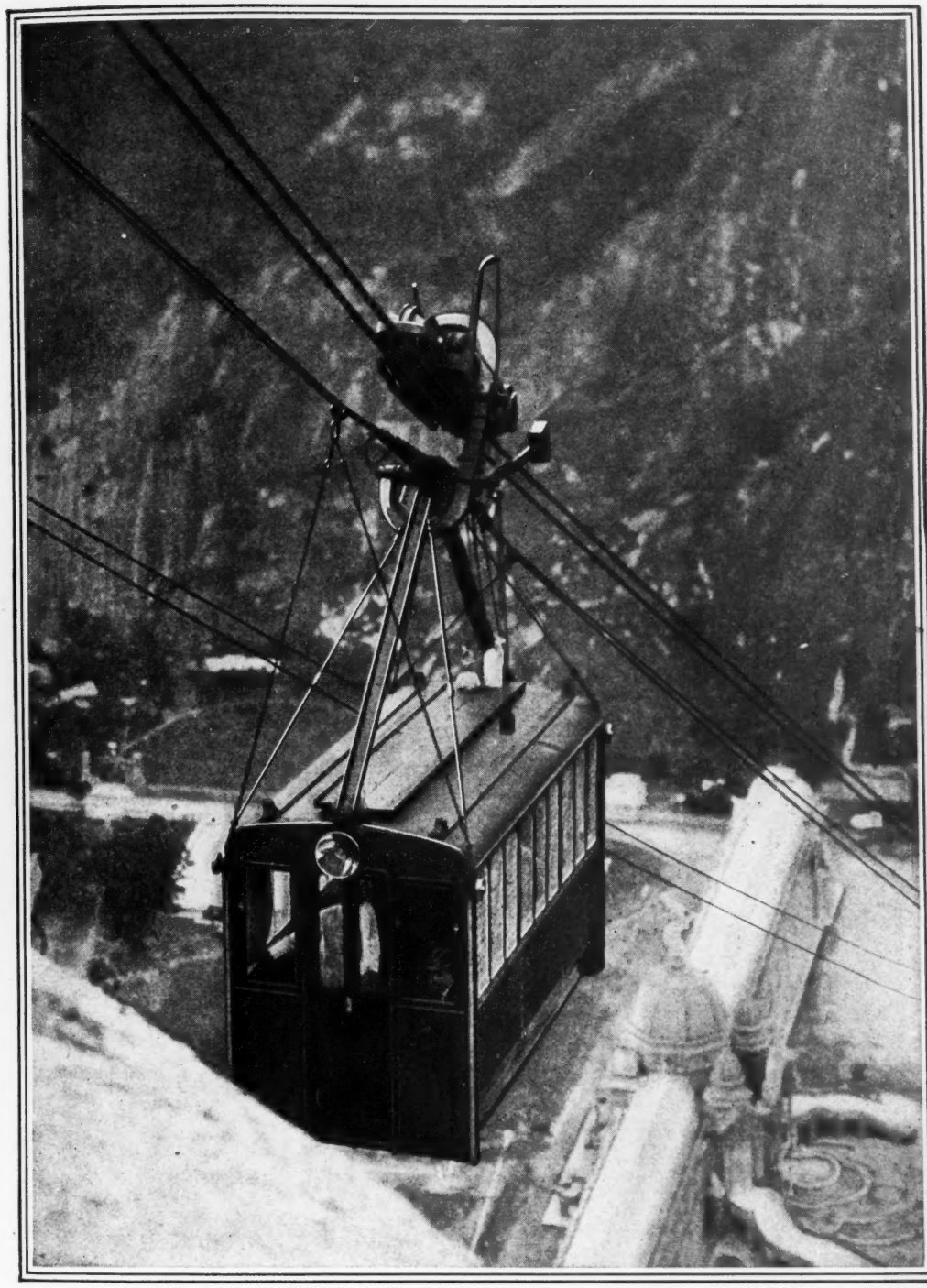


© Newman Traveltalks and Brown and Dawson

The aerial cableway to the top of Sugar Loaf Mountain at Rio de Janeiro. The altitude of the platform in the foreground is about 700 feet, and it takes four minutes to reach it. The mountain is 1,383 feet high. It takes six minutes to reach the top

The trip is one of the most thrilling in the world. The car holds twenty people and the cables are so arranged that if one should break the other would bear the entire weight without mishap

Climbing a Mountain on a Rope



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The cableway was completed in 1912 and it has since been the main sight-seeing feature of Rio de Janiero. The car runs on eight steel wheels supported by two parallel steel cables, each cable offering a resistance of one hundred and fifty tons. There is a thirty-ton counterweight at each end, making the resistance of the cables ten times that of the car and passengers

The Homes of Orchids and Dwarfed Pines

Trinidad is the native home of orchids. These beautiful but delicate flowers are reared best in tropical climates, and the year-round warmth of Trinidad is ideal for them. Orchid-raising is one of the chief occupations of the island; and the United States is their largest customer

Far back in the twelfth century, one of the great Japanese heroes slew his best friend in a quarrel. In repentance, he became a monk. Down through generations, the caretakers of his temple, skilled in tree-shaping and pruning grew this remarkable tree-ship in his memory

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Queer Uses of Human Hair

At top. The Nishi Hongwanji Temple of Japan. Ropes of human hair were used in hoisting the heavy beams

In oval below: Specimen of hair rope used in building the temple of Nishi Hongwanji. At right: A Korean with the typical horse-hair hat

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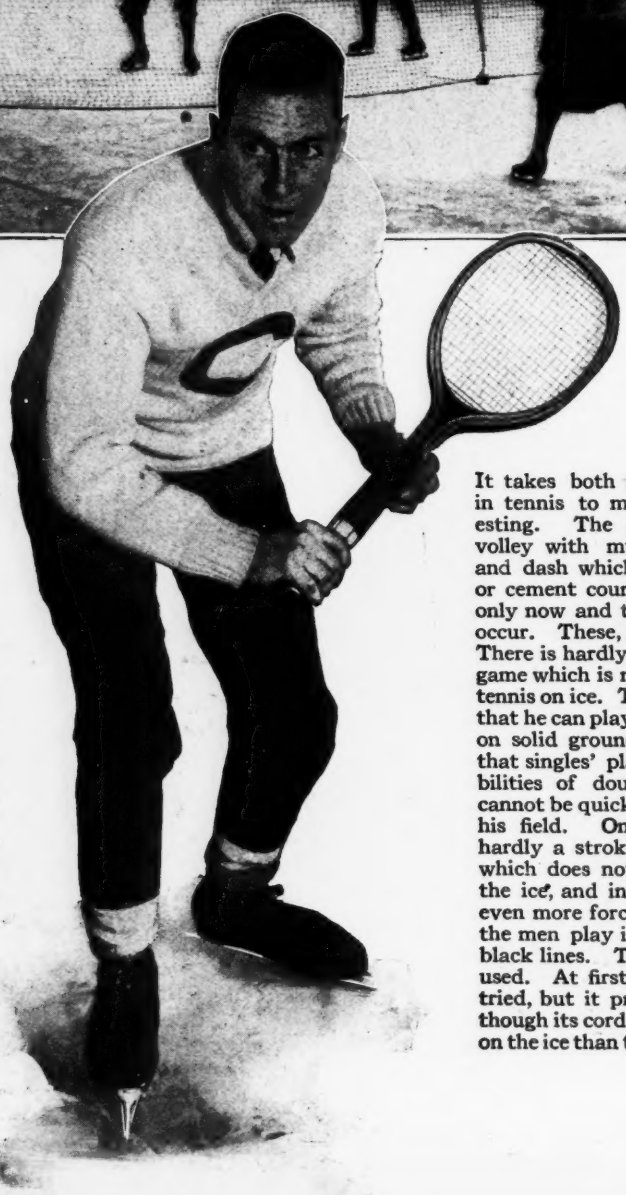
Ice Tennis—the New Indoor Winter Sport



It takes both skill in skating and skill in tennis to make this new game interesting. The players serve, drive and volley with much of the same energy and dash which they display on ground or cement courts, skates hindering them only now and then when occasional falls occur. These, however, increase the fun. There is hardly a stroke of the established game which is not employed when playing tennis on ice. The expert skater soon finds that he can play a swifter game on ice than on solid ground. It is generally agreed that singles' play does not offer the possibilities of doubles' because the player cannot be quick enough on the ice to cover his field. On the other hand, there is hardly a stroke of the established game which does not have its counterpart on the ice, and in some cases the driving is even more forceful. The court on which the men play is marked out with painted black lines. The regulation tennis ball is used. At first a squash tennis ball was tried, but it proved to be too fast, even though its corded surface took a better grip on the ice than the lawn tennis ball covering

India's Sacred Bull Draws an American Lawn-Mower

© Brown and Dawson

Mowing a lawn in India with a modern American lawn-mower drawn by the Sacred Bull. These animals are worshipped in the temples of India and play an important part in all pageants and processions. They do no work except such as this on the temple grounds

Photographing Peru's Lonesomest River

Photo by Pan American Union

Picture-making as they do it on the Ucayali River in Peru. The native boat is hewn from a mahogany log and the platform for the photographers is constructed of light boards and sturdy limbs. The Ucayali is so far inland that few travelers catch a glimpse of its lonely picturesque waters. For this reason photographs of it are especially in demand

Blonde and Brunette Bears of One Species

Photo by American Museum of Natural History

Wherever there are forests, from Maine to California and from Alaska to New Mexico, there are black bears. However, the black bear is not always black. Neither does his color tell you where he lives. In the group above are blue, white, and cinnamon bears, once considered to be different species, but now known to represent merely color phases of one species. The blue or glacier bear (left background) came from Alaska. The white bear came from British Columbia. The cinnamon bear developed from the same litter as the black bear next to it

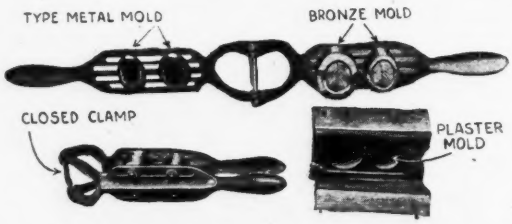
Making Artificial Foliage

Nature requires about six weeks to make a leaf; but a good imitation can be made in a few seconds

Ground squirrels in their natural haunts. The leaves on the tree were prepared by the method described in this article. They were graduated in size and tinted in natural colors

THE modern educators, lecturers and exhibitors insist upon the details accompanying their illustrations being as true to life as the objects upon which attention is to be focused. If a group of specimens from Africa or other parts of the tropics is to be shown, it is considered necessary to have a tropical atmosphere and background. This is not always possible, but the attempt is never an absolute failure, since Science has devised so many ways and means of reproducing natural objects. Especial success has been achieved in representing trees, flowers and shrubs, so that animals, for instance, may be shown emerging from among just such thickets as they would if alive and in their natural haunts.

Above: The clamp in operation. Two leaves are being cast at once. Below the details of the clamp and the leaf molds are shown

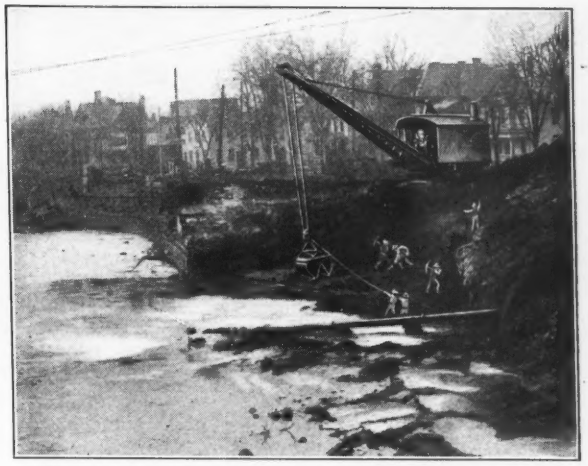


Usually when a tree is to be represented, models of the leaves of different sizes are secured and plaster molds made of the upper and under sides. A fine wire, with a little raw cotton wound around it so as to taper to a point, is laid into the impression of the midrib. Then a thin layer of cotton is spread evenly so as to cover the leaf impression, and a little hot melted wax, tinted to nearly the required shade of green, is poured over it. The mold of the other side of the leaf is then pressed down upon it. The wax soaks through the cotton and spreads evenly, making a perfect cast.

A new method of making these leaves as well as parts of flowers, which will vastly reduce the labor of the operation, has recently been introduced by Mr. A. E. Butler, of the American Museum of Natural History in New York City. He has devised the clamp shown in the illustration. A plaster mold is made from the face of a fresh leaf. This mold is reproduced in bronze and then fitted by means of screws to one side of the clamp. A counter mold is made in type metal on the opposite side of the clamp, thus setting both molds of the leaf in perfect contact position. The cotton and wax are introduced as before. By the closing of the clamp, the two molds are brought together so exactly and quickly that it takes only a few seconds to turn out a leaf. A leaf can thus be made much thinner than with the plaster molds. By using a number of clamps, one leaf may be left to cool as others are being poured. The leaves and flowers are more delicate, also, and consequently truer to Nature than when made by the older method. Therefore when they are wired to the forms representing the trees and shrubs the animal itself, whose environment is being considered, might be deceived if it were a real creature and not merely a product of taxidermy. But the most obvious advantage of the method lies in the reduction of labor.

What the First Telegram Really Said

CONTRARY to general belief, "What hath God wrought?" was not the first message to be sent by telegraph nor was Morse the sender of the first communication. Instead, it was sent by one of the committee who were debating upon the proposal of Morse, the inventor, to string a telegraph line from Baltimore to Washington. Mr. Morse, who wanted to end the discussion and at the same time demonstrate his invention, strung a wire from the committee room to the top of the Capitol. One of the committee, who was opposed to President Tyler, wrote "Tyler deserves to be hanged." This was received by the man at the other end exactly as it was composed.

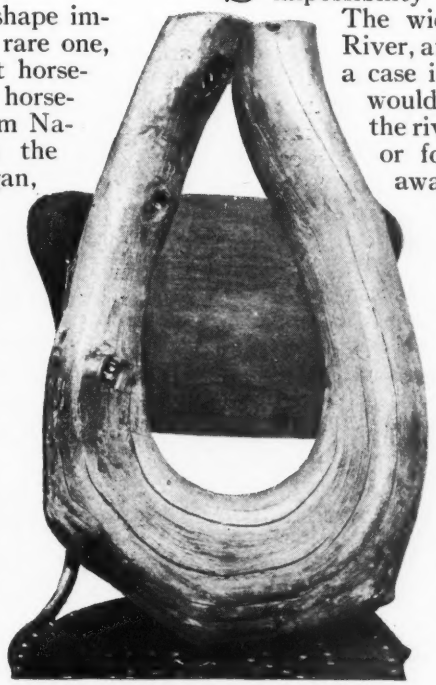


Twenty-five feet of shore were taken away and old walls and foundations removed by the dragline excavator equipped with a one-yard bucket

A Horse-Collar Grows on a Tree

TREES assume every shape imaginable, but it is a rare one, indeed, that has a perfect horse-collar growing on it. The horse-collar illustrated came from Nature's own workshop in the woods of northern Michigan, where it had been growing undisturbed for years until found by the woodsmen.

It is possible that the horse-collar was formerly the top of a slender sapling near the tree on which it was found, or perhaps it was a young pliable limb growing on the tree itself. It was evidently twisted around the tree and fastened in such a way that it remained in that position. This might have been done by some person, although it may possibly have come about from some natural cause.



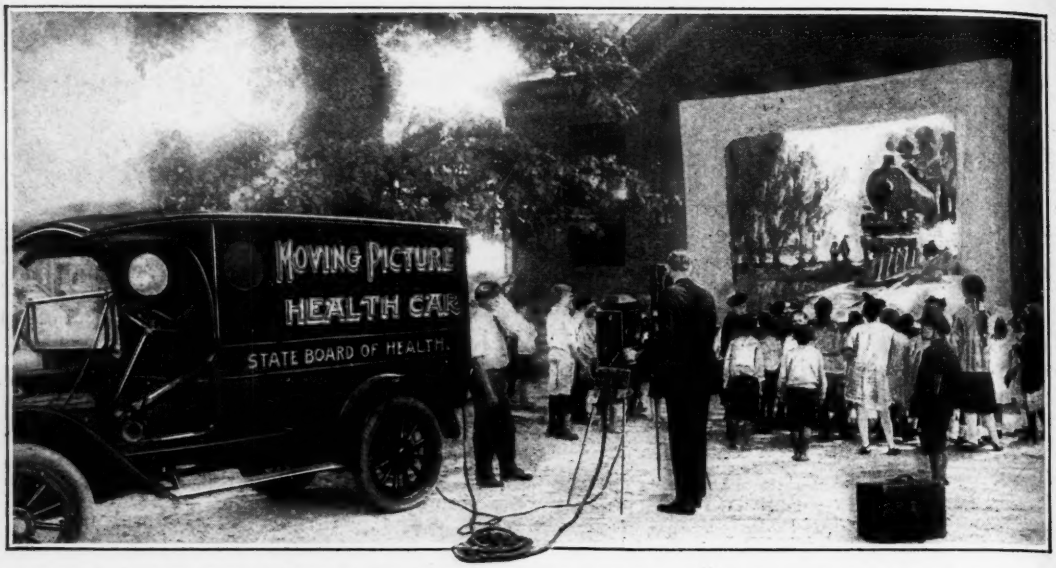
This horse-collar might have been the top of a sapling, or a pliant limb which was made to encircle the base of a larger tree

The collar is grown so perfectly that if the proper rings or snaps were placed on it, it could easily be put to actual use. Compared to the leather collar it would last twice as long, but it would not afford the horse so much comfort.

Widening a River with a Steam Shovel

SCIENCE is proving that there is no impossibility to the truly ingenious. The widening of the Sandusky River, at Tiffin, Ohio, recently was a case in point. Primitive man would have waited patiently for the river to widen its own banks or for storms to wear them away during the course of years, but the engineers made the experiment of using a dragline excavator and accomplished their purpose in short order. Twenty-five feet of the shore was to be taken away, necessitating the removal of old walls and foundations. The excavator, which carried a forty-two-foot boom and was equipped with a one-yard bucket, had no difficulty in clearing away the most formidable obstructions, although several of them were partially under water.

It was also possible by this means to load wagons on the street level, and the river bank was soon cleared away. The apparatus moved by means of caterpillar traction under its own power as fast as the widening of the river on the Tiffin side was completed.



A lecturer has charge of the health car and gives an open air session wherever he stops. It has been found possible to show fairly clear pictures even in broad daylight

Teaching Health Lessons with Automobiles and Motion Pictures

IN order to extend its campaign of education among school children, the North Carolina State Board of Health is using an automobile that is a veritable moving picture booth on wheels. The car carries a projection machine which can be taken out and placed on the ground so as to throw a picture on any wall. The power is furnished by an engine generator. A large sheet is hung on the wall when the state officials wish to show a motion picture.

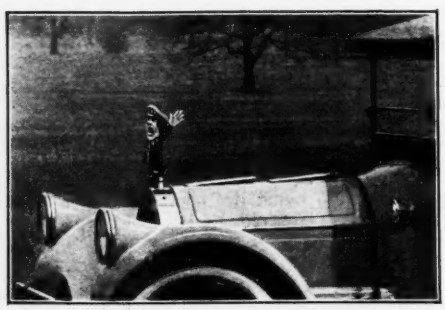
The department has its own reels, to point out reforms which it advocates.

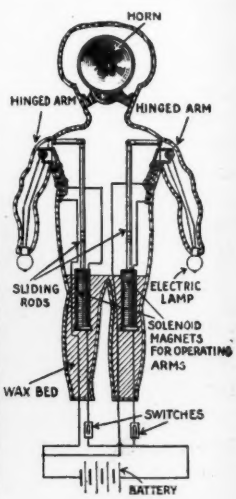
A Motor-Manikin Which Waves Its Arms and Yells

YOU have seen those strange little folk that decorate automobile radiators. Well, the inventors have added a new member to the family—a manikin which throws up its arms to indicate the direction to be taken by the car and then shouts menacingly at you. A simple horn attachment does the shouting; the arms move in and out by means of magnets.

Claud A. Reese, of Bowling Green, Florida, has devised a manikin with its arms provided with electric lights so that it will work at night. When the driver presses a button the figure's arm goes up, and by pressing another button, which operates the horn, the mouth of the manikin opens and he yells realistically.

The arms are fastened to the figure's body with hinges and are operated by a pair of electromagnets. The magnets are placed in the upper parts of the legs in a vertical position so that they carry moveable armatures. Rods connect the arms to the armatures, and when the solenoids are energized a downward or an upward pull is communicated to each of the arms. With its arm-lamps lighted, the figure makes an impressive appearance, which is sure to be noticed.

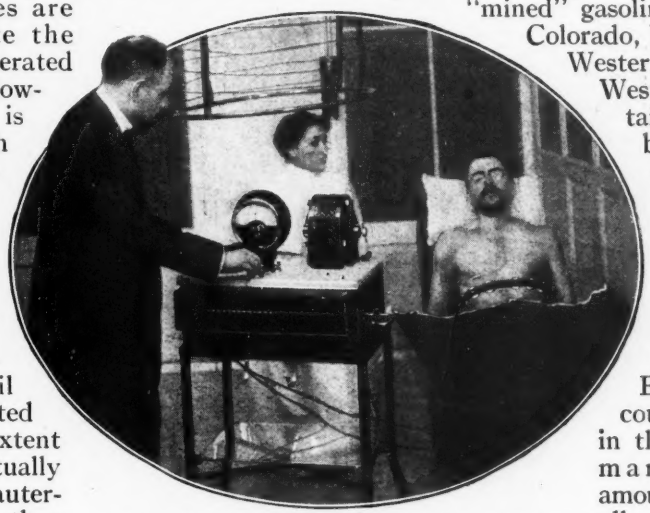




The motor manikin's arms indicate the direction which the car will take as he shrieks a warning. At right is shown the interior mechanism and magnets of the figure

Digest Your Food Electrically! You Can Do It with a Wireless Apparatus

WIRELESS engineers have perfected the "spark" system of wireless telegraphy, until now powerful currents are perfectly controlled. These currents have a decided medical value, and physicians were not long in employing them, first of all in the "baked" cautery method for making bloodless operations. Here sets of small electrodes are placed opposite the organ to be operated upon, and a low-voltage current is applied which may change its direction as many as a million times in one second. The current can be directed upon the particular organ until it becomes heated to such an extent that it is actually "baked!" The cauterized organ may then be removed, if necessary, with little chance of blood poisoning.



The patient could not digest enough food to keep him alive, so electrical stimulation of the organs was resorted to and he recovered

The "wireless apparatus" shown in the accompanying illustration is being used now as an aid to digestion. The patient illustrated was so weak that he could not digest enough food to keep himself alive. The three large electrodes that are shown placed against his side were connected with a branch circuit of the apparatus. The number of times in a second that the current changed its direction was then regulated in the main circuit by the large wire coil seen near the head of the physician. The strength of the current was carefully adjusted, and when the proper values were obtained, the electrodes were "thrown in" with the main circuit. The current, as it coursed through the stomach and its connecting organs, so stimulated the cells that they were soon able to do their work again.

Will the Gasoline of the Future Be Mined?

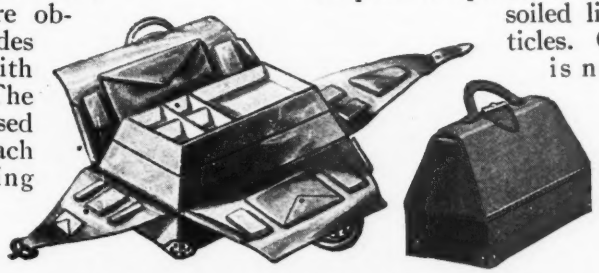
THE latest estimates of the United States Geological Survey show that if gasoline continues to be used up at the present rate, all the petroleum fields now in use will be exhausted before 1950. Where, then, will our future gasoline come from? Billions of dollars are involved in the question. The probable answer is that "mined" gasoline will be used. Colorado, Utah, and other Western and Middle Western states contain extensive oil-bearing deposits of bituminous shale. Crude oil can be extracted from them and this can be distilled further to obtain gasoline. Enough gasoline could be produced in this way to equal many times the amount obtained from all our present-day petroleum fields.

You Don't Need to Dig in This Bag to Find What You Want

A TRAVELING bag which is a veritable wardrobe trunk, if one counts its numerous trays and compartments, has been invented by Samuel H. Wallach, of New York city. The trays are placed so that they taper upward toward the top. Access to them is gained by opening or separating the walls of the body portion of the bag.

The side and end walls of the bag are securely fastened together above the upper tray by a buckle. Several large envelope-shaped compartments are provided for soiled linen and small articles. Only a single lock is necessary to give access to any or all parts of the bag.

Each wall of the bag is provided with pockets into which articles of various sizes may be tucked.



The pigeon-hole idea applied to traveling bags. Every inch of space is utilized, even the flaps

Mechanics of the Secret Service

Protecting the Nation's money-bags

By M. McGuire Telford

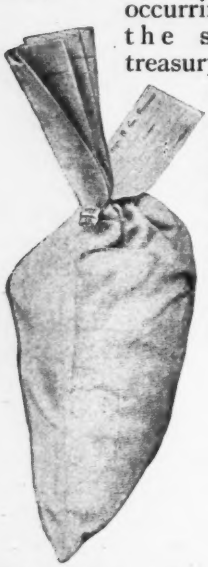
Spying on the men in the sub-treasury as the money-bags are being counted

THE officers at the United States sub-treasury located in Chicago found that there was a small but persistent shortage in the money-bags delivered in truck-load lots from the banks of the city. Careful watching showed that the full amount was sealed in the bags at the banks, but the count was invariably short in the sub-treasury, the difference usually being two, three, or four dollars per bag.

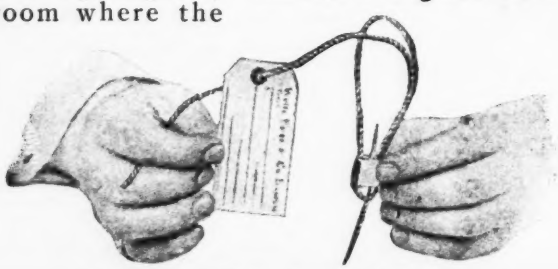
The Secret Service men were called in to solve the mystery. Captain Porter, in charge of the investigation, was convinced that the stealing was occurring in the sub-treasury itself and not in the banks or on the trucks during transportation. To make sure, he had a small chamber built in the top of a toilet room opening from the room where the bags were received and counted. A tiny crack was made near the molding so that a man might secrete himself in the chamber and keep the workers in the room under observation.

Carrying the money-bags sent by the banks of the city by truck-loads to the sub-treasury where they are counted

Captain Porter posted himself in these cramped quarters before the beginning of the day's work. As they came in, the money bags were counted by a young man of twenty-five whose work was supervised by an older and highly trusted employee. Captain Porter saw that as the young man counted the bags he tested the tightness of the fastening on each. Most of the bags were quickly passed along, but a few were set aside in a row on the table. When all were counted and tested the young man turned to those on the table. With marvelous quickness he pulled down one of the folds on the first bag through the cords loosely fastening it, thrust in his fingers, withdrew two or three silver dollars, and in a jiffy pulled the fold back into place. Each of the other bags was treated in the same fashion, the older man in the meantime scrupulously keeping his back turned so as to see nothing. On the third day of the investigation, Captain



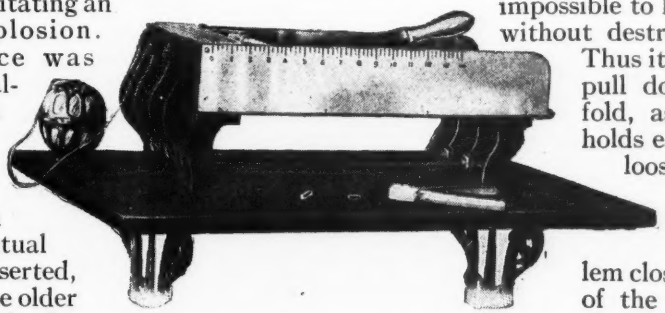
The mouth of the bag is drawn into accordion-like folds



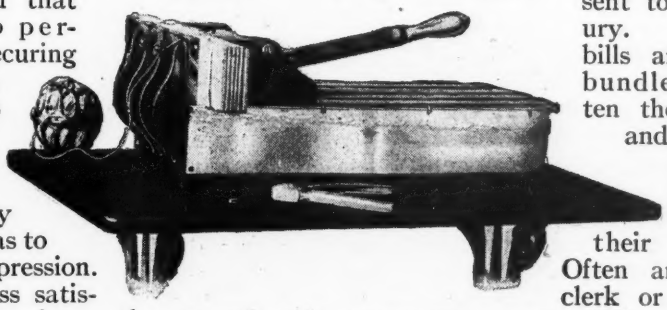
A cord is run through a lead seal and a steel pin is run through each separate fold

The new sealing device for the money-bags

Porter called in a high official of the sub-treasury to see with his own eyes. That worthy was so excited when he saw the young man extracting the money that he came near precipitating an immediate explosion. Legal evidence was secured, and finally a confession obtained. It turned out that the young man had been doing all the actual stealing; he asserted, however, that the older man had shared in the loot, though this could never be proved.

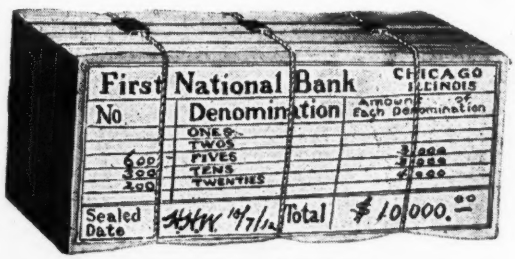


The sealing instrument by means of which the lead seals are crimped so as to make it impossible to loosen the cord. It is operated by means of a lever handle



The work of Captain Porter showed that there was no perfect means of securing money bags. Sealing-wax is not only easily broken or defaced but it can be readily manipulated so as to duplicate the impression. Wax is even less satisfactory. Lead seals can be opened and replaced. With any of these materials a single fold can be pulled down, as described above, and part of the contents of the bag so carefully extracted that only weighing or counting shows the shortage.

Captain Porter proceeded to invent a safety seal that seems to have made successful tampering impossible. Like most effective inventions, the device is remarkably simple. A cord is run through a lead seal and placed around the mouth of the bag, which is drawn into accordion-like folds in the usual fashion. Then a steel pin, attached to the seal, is run through each separate fold. With a sealing instrument the lead is crimped so as to make it impossible to loosen the cords without destroying the seal. Thus it is impossible to pull down a separate fold, as the steel pin holds each in place. A loosened cord betrays itself.

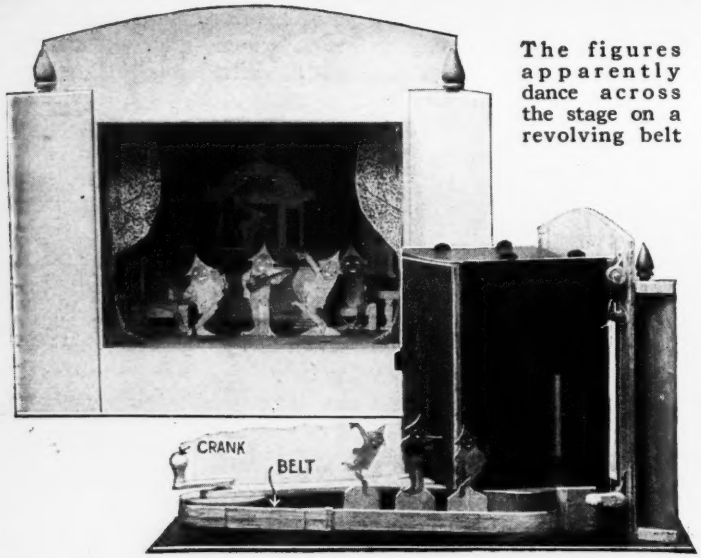


A bundle of bills ready for shipment. Although securely sealed it will not escape from the official eyes of the Government until it reaches its final destination

Another baffling problem closely akin to that of the money bags is the theft of one or more bills from a packet shipped from one bank to another or sent to the sub-treasury. Ordinarily the bills are bound into bundles containing ten thousand dollars, and a slip is placed on top showing the number of bills and their denominations. Often an unscrupulous clerk or messenger extracts one or more bills and then claims that a mistake has been made in the counting and packing. With the ordinary binding, there is no absolute means of proving him to be wrong, as the packet is apparently intact.

A safety currency press invented by C. H. Bohanan makes this sort of theft impossible. Ordinarily a packet of five hundred dollar bills is from 2¼ to 2¾ inches thick. In a press it is reduced to about 1¾ inches and it is then bound with three sealed cords. Owing to the compression it is impossible to extract a single bill without cutting all three cords. An inner steel reinforcement in the lead seal makes breakage impossible; nor can the grip be removed.

By breaking the middle cord and one end cord, the contents may be counted. If there is a shortage the whole packet may be returned to the sender with indubitable evidence that the interior has not been tampered with. The compactness of the bundle also makes this device useful in compressing bundles of checks, drafts, and vouchers for storage in vaults.



The figures apparently dance across the stage on a revolving belt

The Latest Rival of the "Punch and Judy" Show

FOR unnumbered years, it seems, the Punch and Judy show has held its place in the affections of the juvenile public. Now, however, it can no longer hold undisputed sway. A new toy embodying the same general principle, has been invented by J. A. Dunigan, of Albany, N. Y., which is not only as amusing but is capable of great variation.

As shown in the illustration, a number of toy actors are mounted on an endless belt which extends across a guideway in the floor of the miniature stage. The belt is composed of a folded strip of stiff material into which the base pieces of the toys are inserted and by which they are carried across the stage during the performance.

Speaking parts taken by persons behind the scenes increase the interest and the liveliness of the act. Any number of toy figures may be used. They are easily removable so that there need be no monotony in the performance.

How the Office Adding Machine Is Employed in Surveying

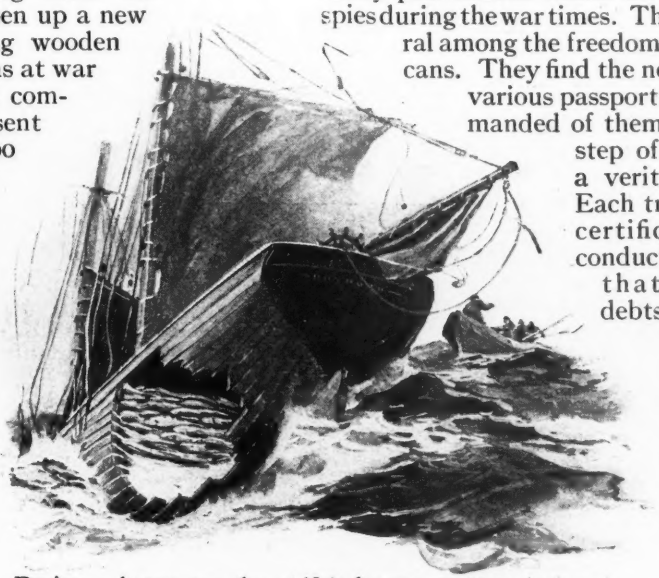
THE illustration on the right looks to be a photograph of one of those ultra-busy men who can not leave their work behind even on a vacation trip. But although the machine in use is the regulation adding machine, such as will be found in the equipment of any office, it is also a part of the traveling equipment of the surveying parties which the United States Geological Survey is sending out to do special leveling work. The adding machine is conceded to be much more reliable than the ordinary clerk, male or female, and the practicability of using it for recording readings of the level rods was proved in connection with work done recently by Government surveyors in certain sections of Florida and Indiana. As many of the observations are made on railroad rights of way, the Government men use motor velocipedes to transport themselves and their equipment from place to place.

When in use, the adding machine is placed firmly on the base of the velocipede and is then strapped on. It is possible to move the car and apparatus along the rails without disturbing the arrangement. This is said to be the first time mechanical adders have been used in the field. The United States Geological Survey reports that recording can be done in this way more quickly and with less likelihood of error than by the old method of entering observations in a record book.

The Government surveyors use motor velocipedes on which the adding machines are strapped for recording readings

A Cargo of Dried Codfish Sank a Schooner

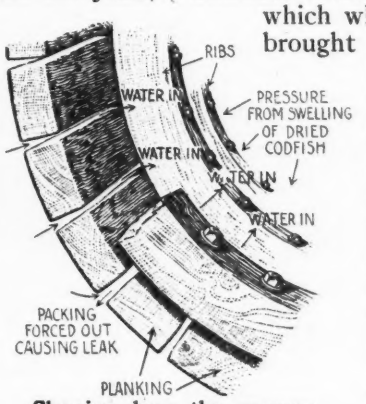
"CODFISH Sank Big Schooner" was the title of a news item of recent date, which besides being most unusual, seems to open up a new method of sinking wooden ships of the nations at war at a trifling cost compared with the present $5,000 to $10,000 torpedoes used by submarines and destroyers. According to the survivors of the vessel, codfish actually sank her, although it took more than one to do it and it was several days before the vessel had to be abandoned. New England's sacred cod has been famed for many things, but this seems to be its most notable achievement.



During a heavy sea the codfish became watersoaked and swelled so much that the seams in the planking of that part of the vessel where the fish was stored were forced apart and the crew was compelled to abandon the ship

Of course the cod did not torpedo or ram the vessel because she belonged to any particular enemy. They sank her simply because they were inside the ship and because they had too much water. The strange incident happened in this way.

The schooner Ponhook, under a captain and crew of seven men, left St. John, N. B., for the Azores, with a cargo of dried codfish. Soon afterward she ran into a heavy sea and shipped considerable water. The dry codfish absorbed this like a sponge, and it was but a couple of days before the expansive pressure of the swelled codfish had forced open the seams of the vessel's planking so that the water began to seep in, little by little, as shown in the accompanying sketch, until the ship was beyond saving and had to be abandoned.



Showing how the pressure exerted by the swelling codfish forced the packing out of the planking, causing leaks

Discovering the Spy's Secrets by Means of a Lemonade Bath

TRAVELERS through Germany are likely to regard with resentment the many precautions which are taken against spies during the war times. This is only natural among the freedom-loving Americans. They find the necessity for the various passports which are demanded of them at every new step of their journey a veritable nuisance. Each traveler needs a certificate of good conduct; one showing that he has no debts; one from the secret service showing that he is not suspected; a similar one from the military authorities; one showing that he has no vermin; one signed by the consular officers; a permit to travel, and a permit from the station master to use the train.

But the entire collection of passports will not exempt him from being subjected to the lemonade bath, which is the last cry in the methods employed for discovering spies. The necessity for the lemonade bath arose when it was found that information and maps were being carried over the border tattooed on the skin of the informants. The skin-writing is done with a chemical which when dry is invisible, but is brought out by another chemical when the spy reaches his headquarters. The citric acid of the lemon juice serves to bring out these written characters also, or to destroy them. As there is no way of telling whether or not a traveler is a walking manuscript, written all over or in spots, the entire body is given a vigorous rub with the lemonade. The only way for man, woman or child to avoid it is to refrain from attempting to cross the German border.

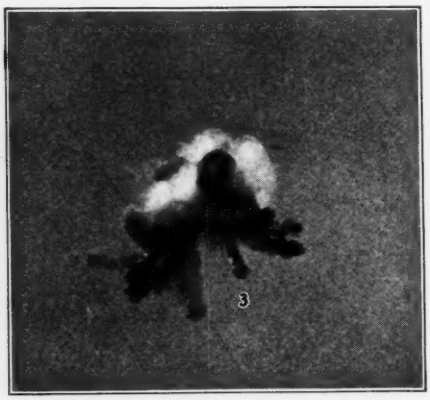
Tricks of the "War Photographer"

How a remarkable "air" battle is staged thousands of miles from any battle-field — in New York!

By J. A. McManus

BIFF—Bang—Boom—Crack—Crash—or any other words that convey the impression of bursting bombs, the hum of many aeroplane motors and propellers, the sounds of big "Archibalds" sending forth their messages of death and destruction, the echo upon echo of the boom of bursting of big shells—it's all there in the accompanying photograph "War in the Air." Is it not?

A quiet photographers' dark-room, some stories above the noise and bustle of New York's beehive, an enlarging camera, some enlarging paper, size 11x14, a collection of negatives, (Picture No. 3, shown at Numbers 1–2–3–4–5–6) photograph of a balloon that was set on fire at Sheepshead Bay, N. Y., by Daredevil Rodman Law, and which really looks like a bomb explosion; (Picture No. 7, which is a close-up photograph of an Allied aeroplane, shown also at 8 on the following page); two photographs of aeroplanes in air, Number 10 being the same as Number 9, but thrown out of focus slightly; a cloud scene taken over New York; a fund of imagination; a sense of proportion; unlimited patience—result, a composite picture that looks remarkably like a real air-battle photograph.

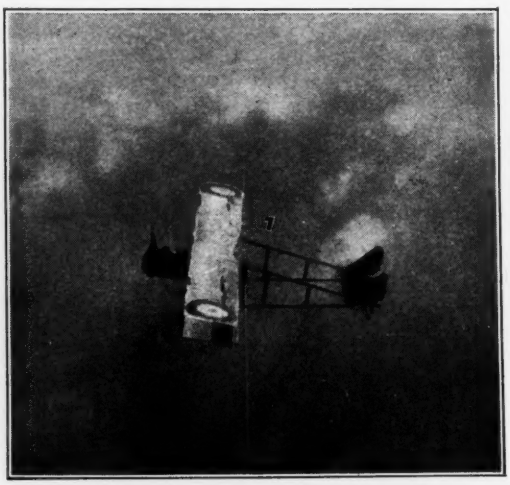


Photograph of a balloon that was set on fire at Sheepshead Bay, New York, by Rodman Law. It is used to represent a bomb explosion

The secret behind it all is in the right timing of the exposure of each negative and in the fact that once a spot on the enlarging paper is fully exposed, you cannot expose on it again; but, if the first exposure is just a little under-timed, and the second a little under also, both exposures will blend together when put through the developer and fixing bath.

Before the actual exposures were made, a sheet of white paper of the same size as enlarging paper, was placed on an enlarging board. The different negatives, with the exception of the cloud negative, were thrown on it through an enlarging camera, and the relative sizes and positions were plainly marked out on it, as they appear in the accompanying illustrations.

Numbers 1–2–3–4–5–6 (on picture on following page) are exposures of the same negative through a ragged hole in a sheet of paper held between the light from the lens of the camera and the paper on the enlarging board. This exposure is called "vignetting." The paper used was large enough to block out all light from the rest of the enlarging paper and was moved with a circular motion around the spot exposed to prevent the edges of the hole from showing in developing. The different positions of the same negative were obtained by turning the paper on the



A close-up photograph of an aeroplane belonging to the Allies. The same picture is used again and again but differently focused and in various positions

A Perilous Air Battle—in a New York Studio

Before the actual exposures were made, a sheet of white paper of the same size as enlarging paper, was placed on an enlarging board. The different negatives, with the exception of the cloud negative shown on the right, were thrown on it through an enlarging camera, and the relative sizes and positions marked out. Numbers 1, 2, 3, 4, 5 and 6 are exposures of the same negative through a ragged hole in a sheet of paper held between the light from the lens of camera and the paper on the enlarging board. Numbers 7, 8, 9, and 10 are differently focused views of the same aeroplane

enlarging board.

Before each exposure, the size and position was obtained on the sketch of the whole picture. With the ruby or orange cover on the lens, the enlarging paper was placed exactly over the sketch paper. Then the exposure was made. Both papers were taken down before the next exposure, or changing of negative.

The effect of distance is obtained by making the object smaller and slightly undertiming the exposure. The longer the exposure, the sharper, clearer, and nearer the object will appear to be when the paper is developed.

Exposure No. 1 was over a section of No. 7, and when the latter was made the former blocked out certain parts.

In exposures 8–9–10 the appearance of distance was obtained by gaging the time of exposure and the size, and also, as in No. 8 and 10, by throwing the negatives slightly out of focus when exposing.

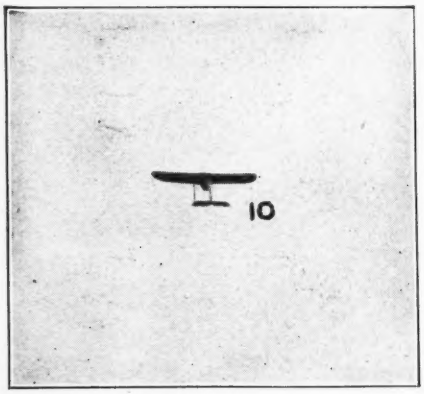
In exposure No. 11, the cloud background was exposed over all the paper and greatly enlarged, only a section being used. Care as to the correct timing had to be taken. In fact the exposure was undertimed, as the least bit of overexposure would have spoiled the entire effect.

Care was taken at all times to avoid fogging of the enlarging paper.

A variety of beautiful as well as startling pictures can be made by this process of composite enlarging and printing. The average amateur as well as professional photographer has any number of negatives which when combined will make truly wonderful pictures—pictures that cannot be distinguished from actual photographs.

But patience is necessary. The "War in the Air" took four tries, and the last picture consumed one hour and twenty minutes making the exposures.

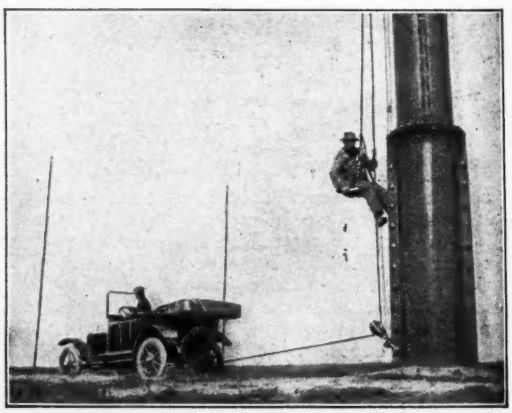
The photograph marked 9 is the same as Number 10 except that the latter is differently focused



Hoisted by an Automobile up to the Clouds

PERHAPS the queerest use to which the automobile has been put is that illustrated in the photograph below. It shows a steeplejack resting confidently on his nerve and on the end of a steel cable, the other end of which is attached to an automobile below. He is being hoisted to the top of a gigantic steel mast, towering high in the air, to give attention to the antennas of the largest wireless plant in the United States, which is located at Bolinas, California, about fifteen miles northwest of San Francisco.

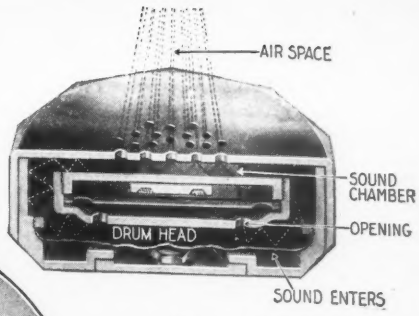
A. A. Isbell, engineer in charge of the plant, states that the steeplejacks prefer an automobile to a horse for the hoisting, since the flat cattle range surrounding the base of the masts make the automobile practicable, and the machine is more reliable and insures more steadiness in the ascent than a horse. The plant has nine of these great tubular steel masts, so that considerable work aloft is necessary.



The other end of the cable is fastened to a moving automobile which is hoisting the jack three hundred feet to the top of the mast

Helping the Deaf to Hear with a New Electrical Ear

A NEW instrument to help the hearing of the deaf is so constructed that buzzing and grating sounds are entirely sifted out. The sounds received are actually increased in volume so that practically every partially deaf person can hear with its aid. The clearing of the tone is accomplished by carrying the sound-waves through the receiving mechanism in much the same way that a stream of water is sprayed out by the presence of a button in the middle of the nozzle. Hence the sound does not bound out of the instrument, but is carried around and thrown back on the diaphram of the microphone, after all rumblings have been lost in the steel passages corresponding to the auditory canals of the normal ear.



Above: The electrical ear, showing how the magnifying of the sound is accomplished by the drum-head

The transmitter is easily concealed in the clothes and the ear disk is reduced to a very small diameter

The magnifying of the sound depends on the drum-head or sounding board which is buried in the heart of the instrument. The sound, after entering, is carried around through the sound chambers. It strikes on the curved surface of the drum-head, from which it is deflected through a perforated screen to the diaphram of the microphone. The drum-head is made in varying degrees of curvature, and of different materials and thicknesses.

The makers of the instrument have also prepared a testing system, not unlike an optician's test case, by which a physician can determine exactly, not only the proper curvature and thickness of the drum-head, but also the material of which it should be made. This varies from brass to lead, with silver, rubber and glass in the list. It has been found that the material gives the quality which is vital in getting just the pitch which will affect what sense of hearing is left. It is claimed that by careful fitting, as to form and material, in the drum-head, the deaf person can be made to hear nearly all words and sounds in their natural tone.

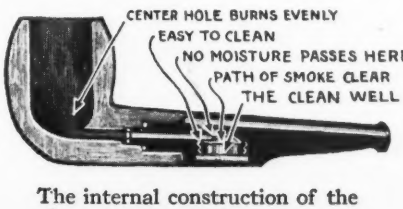
The new instrument is the product of the inventors who perfected the wire-tapping telephone instrument which figured so prominently in the news a few months ago, and they have adapted to the perfection of the new ear-phone the same principles which made the "listening in" inaudible. Heretofore, electrical manipulation and tuning have been the only means of increasing the efficiency of the microphone, but with the new ear-phone, this electrical adjustment is aided in its work by the ingenious mechanical developments of the drum-head and the open spaces inside the instrument.

The disk that goes to the ear is reduced to a diameter of an inch and one half, and the transmitter, three inches in diameter, is easily concealed in the clothing.

A New Pipe Which Is Sanitary and Nicotine-Proof

PIPE smokers are ever on the alert for a pipe which is nicotine-proof. The disadvantage with pipes which claim to live up to this feature is that they cannot be cleaned readily. They clog up with small particles of tobacco.

The pipe illustrated can be cleaned whenever the smoker wishes. Furthermore, nicotine can not be drawn through the stem, since the stem is disconnected, allowing all moisture to drip into an easily cleaned well.



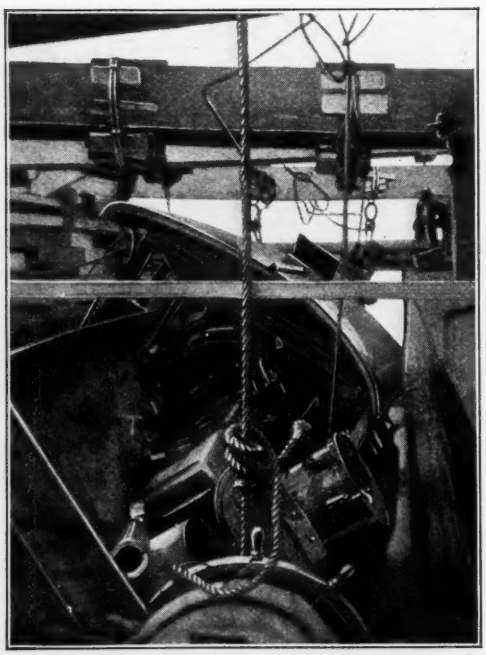
The internal construction of the pipe, showing the cleaning well and the path the smoke takes

Rescuing a Drowned Locomotive

How a one hundred and twenty-ton engine was raised from the bottom of the bay

WHILE handling a pile driver equipment used in rebuilding an old trestle at San Pedro, Cal., a one hundred and twenty-ton locomotive broke through its track, toppled over the piling supporting the trestle and fell down a sloping embankment to the bottom of the bay. It went through thirty feet of water and half-buried itself, top down, in slime and mud.

A floating derrick barge with equipment powerful enough to raise the engine was not available. A local railroad superintendent finally devised the ingenious method illustrated by which the big engine was successfully recovered.



The first operation was to turn the engine and its tender right side up by means of cables attached by a diver

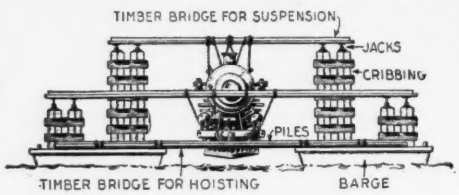
Two barges, each of two hundred-ton capacity, were floated out over the approximate location of the "drowned" locomotive. They were placed parallel to each other and united at each end by two girders made of three logs of twenty-foot piling lashed together with a four and a half inch manila rope tied about the piling and bits. As each turn of this lashing was made a hoisting engine was used to pull the rope tight. A complete coil of rope was used at each end of the girder, and several short lashings were made between the ends as well.

Before the hoisting work started, some objectionable pile stumps had to be sawed off close to the bottom of the bay by a diver with a short piece of cross-cut saw. The first operation, necessary was to turn the engine and its tender right side up. This had to be done in two operations as the tender and engine could not be separated, owing to their depth in the slime.

To support the engine, three clusters of large timbers were rigged across the barges. Two of these were placed at each end and one in the middle. From these supports one and one half inch steel cables were dropped to the engine, passed under it and made fast to it by the diver.

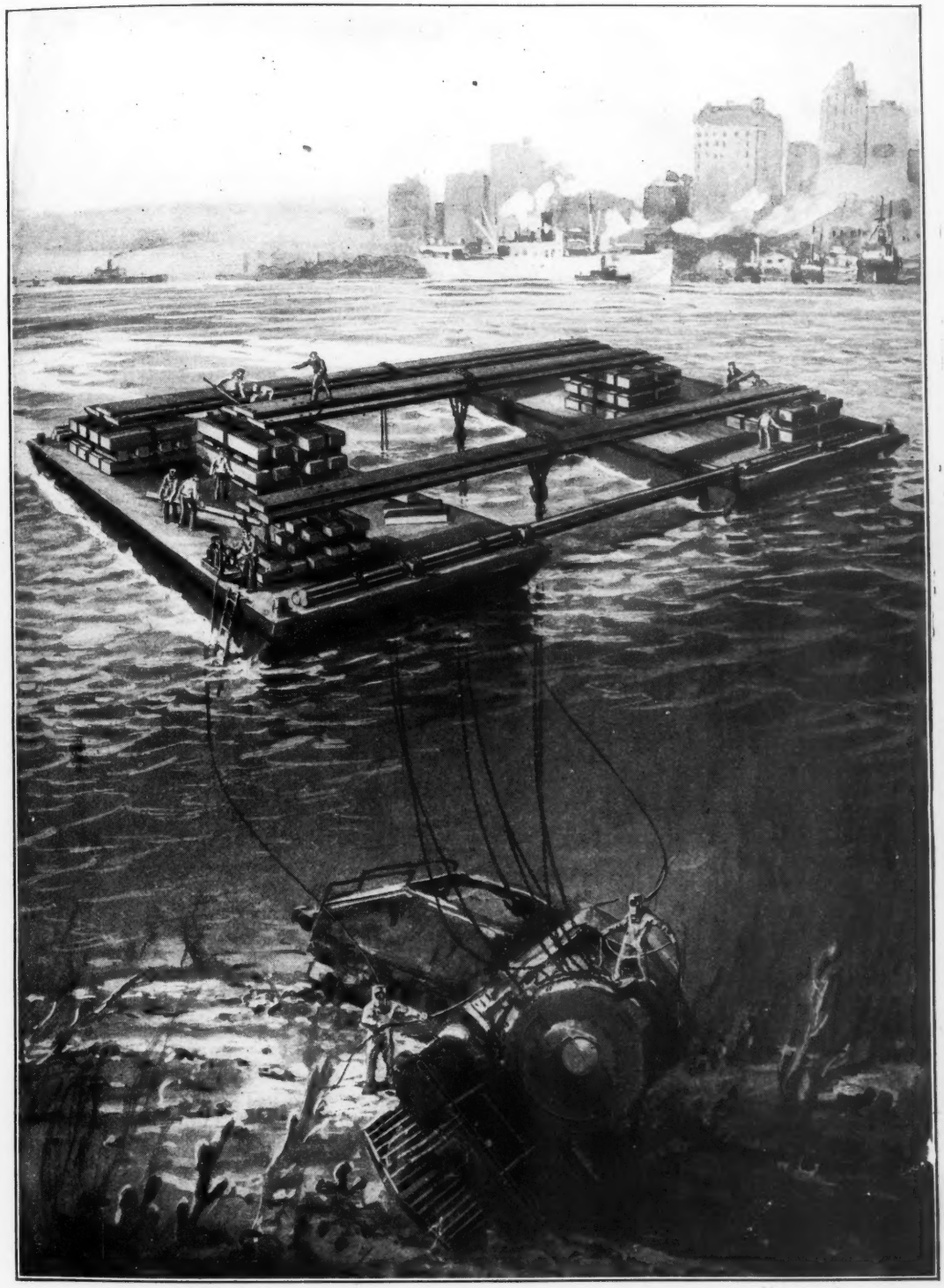
When the cables were all made fast below and drawn tight about the supporting timbers above, fifty-ton hydraulic jacks were placed at each end of the supporting bridging. As the supports were jacked up, railroad ties were inserted under them for cribbing in the manner shown in the pictures.

After the engine was turned rightside up the cables had to be readjusted and more units attached. The hoisting then continued until the cribbing had been built about ten or twelve feet above the deck of the barges. Extra cable lashing was put on to hold the engine in suspension until the cribbing was removed and the supporting timbers lowered back to the deck of the barges. By repetitions of this performance the engine was elevated sufficiently from the bottom of the bay, so that it and the barges could be towed intact on to some mud flats half a mile distant and close to a spur railroad track. The whole equipment was pulled aground by a locomotive.

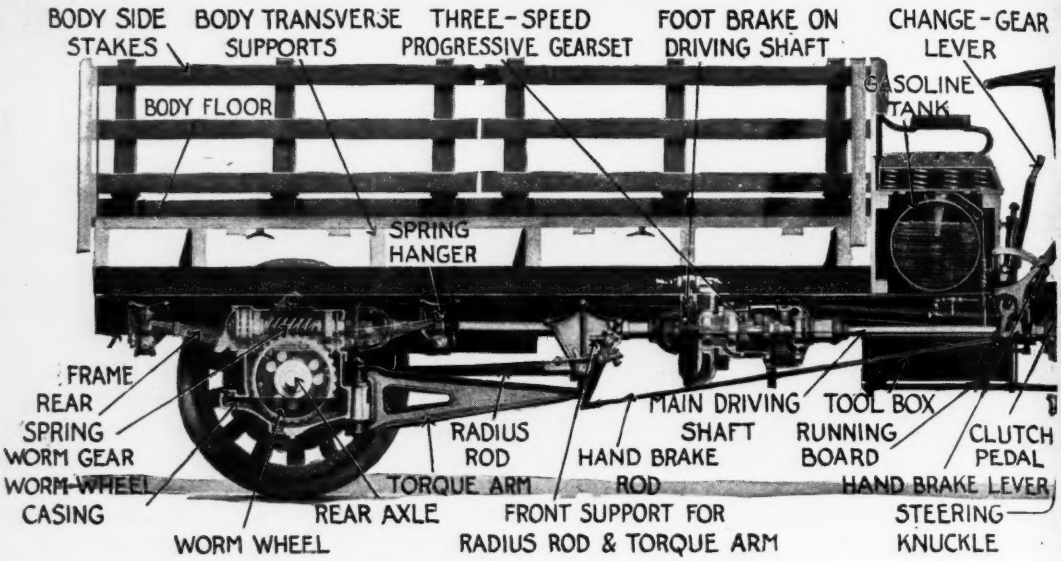


Railroad ties inserted for cribbing under the supporting bridging. The hoisting was continued until the cribbing was ten or twelve feet above deck

Towing the Recovered Engine to Land



Two barges were joined together by means of girders, and a hoisting engine was used to right the locomotive and hold it in suspension between the girders until the barges could be towed onto some mud flats close to a spur railroad track, drawing the engine with them



If you took a huge knife capable of cutting hardened and heat-treated steel and slashed it down through the center of a modern motor-truck from one end to the other, the result would be something like this picture, in which all the vital parts of the vehicle are exposed to view. Note how compactly the internal parts are arranged despite the long wheelbase of the vehicle, and how few rods are exposed to the wear and tear of travel. Another significant feature revealed

A Pushmobile De Luxe for the Youthful Speedster

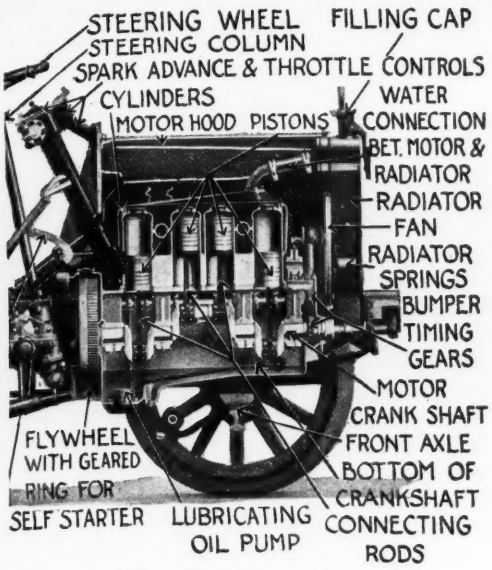
A THREE-WHEELED vehicle built for boys and girls from eight to fifteen years of age is the latest addition to the pushmobile family. It is operated by hand by means of a forward and backward lever and rack movement. As shown in the accompanying illustration, it is made of bicycle parts and is steered with the feet. The front and rear wheels are placed far apart to prevent overturning. It is equipped with a bucket seat of the racing car type, and other up-to-date paraphernalia.

The latest thing in pushmobiles. It is operated by means of a lever and rack movement and is equipped with all the pushmobile refinements including a hand-horn and an electric searchlight

Where Is the Automobile Seemingly Most Popular?

TWENTY years ago the horseless carriage was in its earliest experimental stages. To-day there are more than two and a half million motor cars in the United States—a car to every forty-one persons! In sixteen years the revenue derived from automobile licenses alone has grown from less than a thousand dollars to more than eighteen millions in the year 1916. Ninety per cent of this amount was spent on road and highway improvements. But perhaps the most interesting facts in the automobile industry relate to the car-per-population figures. Iowa, for instance, has a car to every fifteen persons, while New York, our richest State, has a car to every thirty-nine persons. In other words, Iowa, in proportion to her population, has twice as many cars as New York, and twenty times as many as Tennessee.

The Southern States have the lowest averages of automobiles according to population, while the Western States have the largest.



is the number of gears and gearsets. Note how carefully the weight has been distributed. This is a most important consideration in the construction of the modern motor-truck and automobile

Two Workingmen's Tandem Motorcycle

DIFFERING from other two-seated motorcycles in that the riders sit side by side on a common seat instead of one behind the other, the motorcycle shown in the accompanying illustration is used by two Norwalk, Ohio, workingmen to ride to and from their work each day.

The machine, with its ability to carry its two passengers between seventy-five and one hundred miles per gallon of gasoline at speeds up to forty-five miles per hour, offers a quick and cheap method of getting to and from work. Furthermore, the weight is more evenly distributed over the rear or driving wheel, effecting a considerable saving in tire wear and insuring easier and steadier riding. The man driving the machine generally sits on the left-hand side, because the clutch is operated from that side.

The old idea of sitting behind the driver gives way to something better. The two men sit side by side on a common seat

Making the Front Axle Help in Driving the Automobile

THE idea of using all four wheels in driving an automobile has struck many an engineer and has tempted him to work on the problem. The demand of the automobile-buying public seems to be constantly for more power regardless of whether it affords additional comfort or not. Obviously, the advantages of making the front axle help in driving, lie not only in obtaining far better traction and thus more power, but in simplifying the driving gears as well.

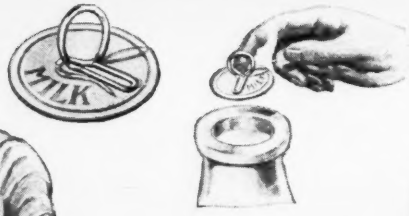
From the standpoint of the automobile engineer the great difficulty, however, has been with joints on each end of the axle, so designed that they allow the wheels to swing about them and thus transmit the turning power at the same time. In trying to combine these features in one axle joint many inventors have met their Waterloo. The fact is that the stress from the transmission, plus the stresses which would be obtained from riding over rough roads would prove too heavy a load for a joint of this kind to withstand.

Notwithstanding these difficulties, it appears that a Dutch engineer, Peter J. Batenburg, has conceived a workable plan. By relieving the axle joint of the function of serving as a turning support, Mr. Batenburg uses it to transmit power only to the front wheels. The casing around the axle members is made into a joint which works very much like a guided ball-and-socket joint. It is this joint which takes up all stresses due to turning and to supporting the body of the automobile. The axle itself is made flexible by a suitable joint and it fits loosely inside this casing. It makes easy connection with the hub of the wheel through a steel plate at its end.

All stress is taken up by the supporting joint and no weight is left to be borne by the weaker axle inside.

Housekeeping Made Easy

An arm-band for use with the gas or electric iron, or with any tool having a tube to be kept out of the way

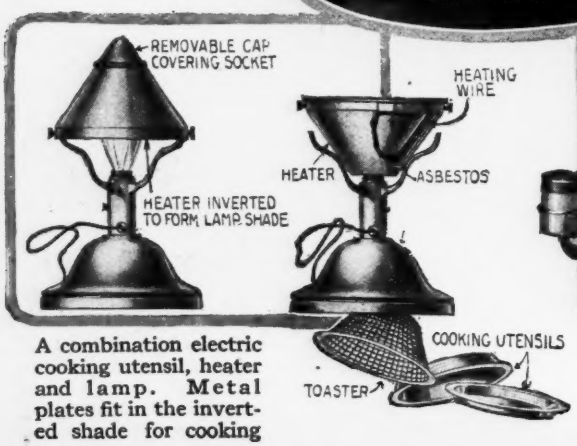


A handle and lifter of non-rusting metal, for removing the paper covers from milk bottles

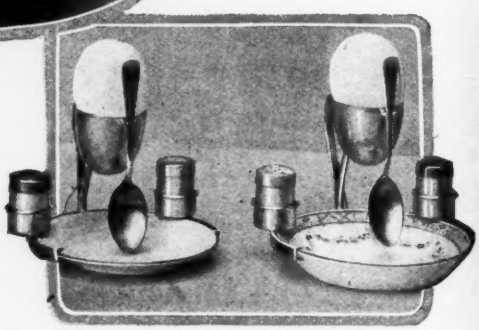
An aluminum egg-beater that does not waste the contents, and is easily cleaned. The gears are machine cut

At right: A burglar-proof galvanized iron delivery box with three compartments. The weight of the parcels placed upon a false bottom in the box automatically locks the section

At left: The box is fastened to the side of the house just below the window-sill. The top lid is automatically locked or unlocked by the same action which closes or opens the window

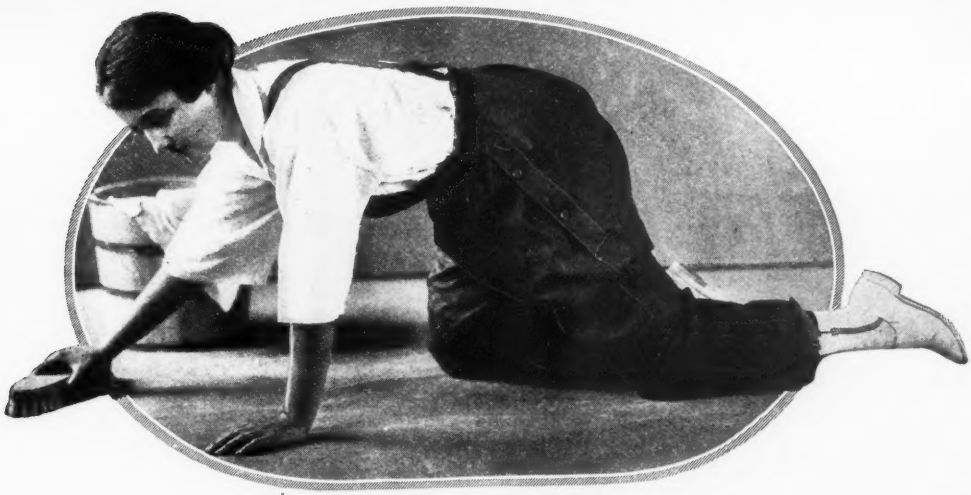


A combination electric cooking utensil, heater and lamp. Metal plates fit in the inverted shade for cooking



A complete egg service consisting of a gilt-lined silver-plated egg-cup, salt and pepper shakers, spoon, and rack from which the china plate is easily detached

Housekeeping Made Easy



Denim or khaki overalls for women! The very latest idea for the strenuous Spring housecleaning

A new type of caster which fastens around the furniture leg and looks like a metal finish

A Japanese method of hanging flowers and plants. The pots balance each other, so that either can be readily pulled down to water the flowers

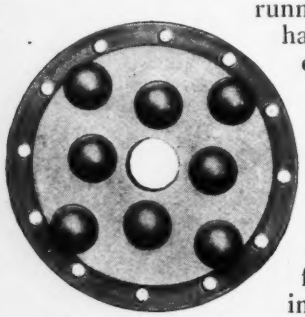
The overalls are voluminous enough to enclose the skirts and protect the stockings

A shoe and slipper container which resembles a cretonne-covered shirtwaist box

A New Ball Differential for Automobiles

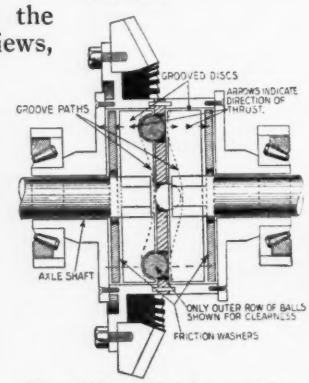
It will enable a car to get out of a hole when only one wheel grips

A NEW differential for automobiles has just been put on the market which differs from all previous types in that the differentiation is secured not through gears but through the friction of steel balls running in grooves. It has an advantage over former designs in that while the power of the motor is differentiated between the two wheels in the usual manner for corner turning, it will still allow a car to pull out of a hole when only one wheel has traction.



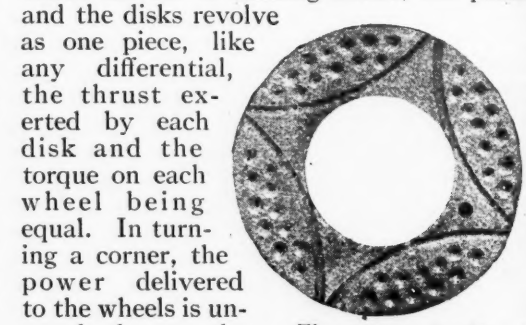
The center plate is of chromo-nickel steel into which are fitted steel balls

As shown in the accompanying views, the device consists of a conventional differential casing at the center of which is a plate carrying eight steel balls arranged on two concentric circles. These balls move in crescent-shaped grooves in two disks, one on each side of the plate. The disks carry the ends of the axle shafts. Each groove is deep and wide at its middle, tapering off to points at the ends. The deepest part of the groove and the thickness of the center plate are each one-half the diameter of the balls. When any one ball is at the deepest part of the groove on one disk, it is at the end of the corresponding groove on the other.

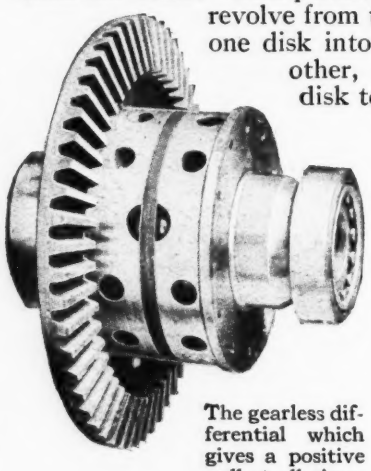


The differential in position and the relation of the working parts to each other

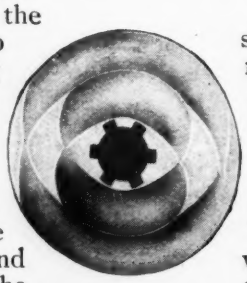
The transmission of the motor power through the large differential ring gear to the plate carrying the balls creates a thrust which tends to force the disks apart, causing them to press against grooved washers in the ends of the casing. When the car is running ahead, the plate and the disks revolve as one piece, like any differential, the thrust exerted by each disk and the torque on each wheel being equal. In turning a corner, the power delivered to the wheels is unequal, due to the tendency of one wheel to turn faster than the other. This permits the balls to revolve from the grooves of one disk into those of the other, causing one disk to move faster than the other and similarly allowing the outer wheel to turn faster than the inner. If one wheel is spinning, the friction induced by the disks arrests the spinning wheel and converts its motion to torque on the stationary one, the spreading of the disks acting as a brake on the spinning wheel because only on that side is there relative motion between the disk and its case. As it is the inner wheel which usually slips when an automobile turns around a corner, the action of the new ball differential is considered an improvement over the old type bevel gear. It is being used on a number of cars.



The power shaft of the automobile turns the ball-plate



The gearless differential which gives a positive pull at all times

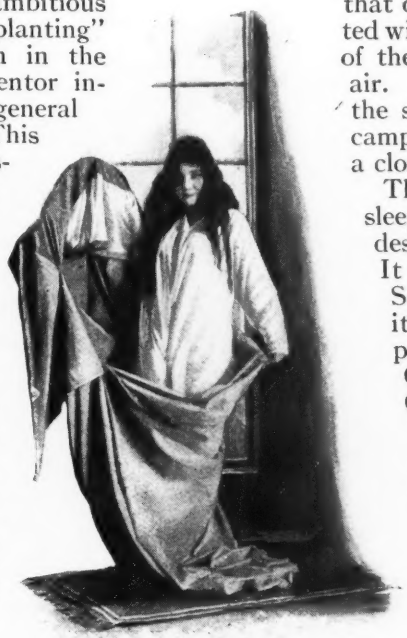


The balls move in crescent-shaped grooves in two disks

How the Bath-Tub May Be Transplanted or Concealed

OF the many queer devices that have recently been patented to make the most of the limited amount of space in modern apartments, the concealed bath-tub of a resident of Cincinnati, Ohio, is one of the queerest. The ambitious invention provides for "transplanting" the bath-tub to any room in the house, without, so the inventor intimates, detracting from the general appearance of the rooms. This seems to be especially possible in the bedroom, for here the tub may be easily concealed at the bottom of the dresser or of the chiffonier.

The dresser is made up into a rather unusual model. It is divided into one stationary part bolted to the bedroom wall, and another movable part mounted upon casters. The stationary part contains a mirror and a compartment for soap and other articles. But the movable part consists only of two rows of drawers and a wash-basin, for the space under these must be used to cover up the tub. When this part is in place against the wall, a pipe leading from the water-outlet of the basin comes directly over a catch-basin attached to the bath-tub, so that, by opening the faucets, the water will be directed into the tub. When the tub is sufficiently full, the dresser part is rolled away, and the splashing of the bedroom wallpaper may commence!



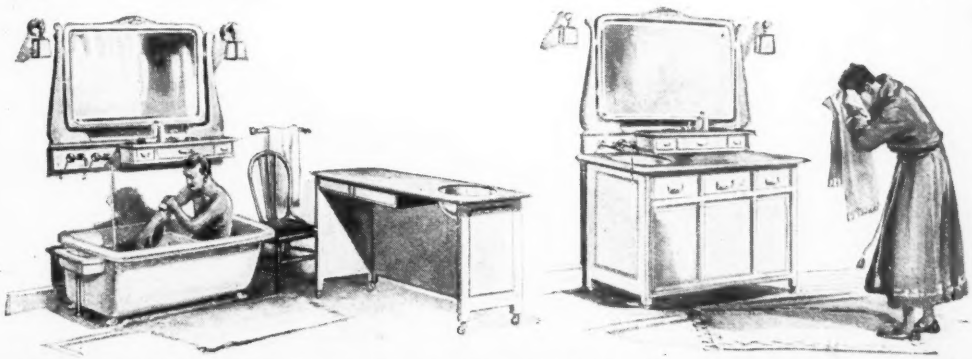
The disrobing may be done inside the bag where there are pockets for clothing and valuables

A "Preparedness" Sleeping Outfit for the Camp

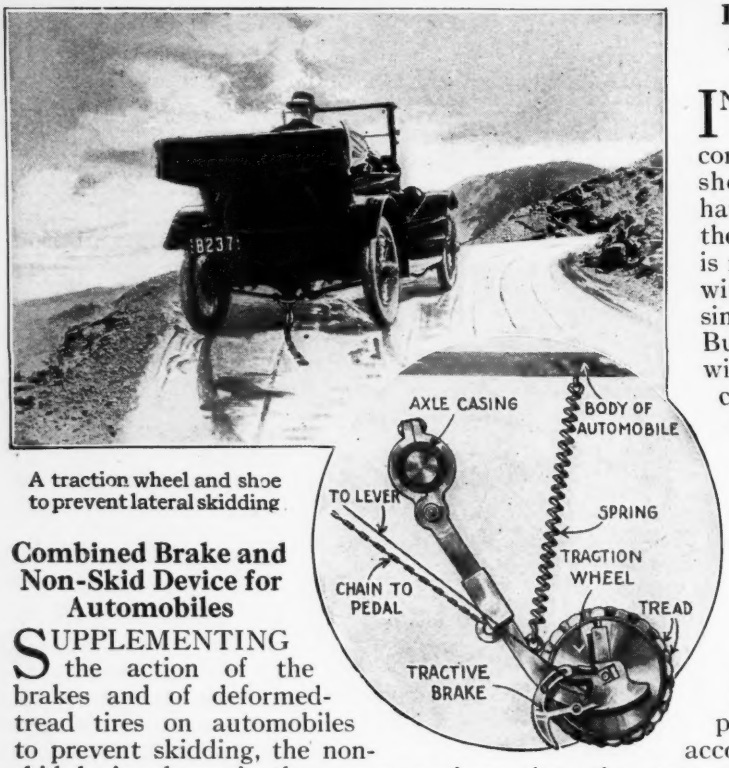
MORE and more attractive grows the idea of spending the night under the diamond-studded canopy of sky with the untainted ozone saturating the lungs. The principal argument against it is that one is likely to be saturated with a less pleasant product of the out-of-doors than fresh air. Rain is the chief foe of the sleeping porch and of the camp, though mosquitoes are a close second.

The latest improvement in sleeping bags, however, is designed to rout these foes. It is in use by the United States Marine Service, and it is waterproof, weatherproof and mosquito-proof. C. W. Sirch, of Alhambra, California, is the inventor. The bag is roomy and comfortable, being seven feet six inches in length and four feet three inches wide. A hood protects the head, and a netting is attached by special fasteners to keep out the mosquitoes.

To prepare the bag for use it must be spread out and a rattan bow adjusted to hold the hood in place. A woolen blanket may be wrapped around the body if extra warmth is needed. There is a pad inside and a bolster, besides pockets in which valuables may be kept. The bag is of felt and is adaptable for use in warm weather or cold.



At left, the bathtub is shown in use, the concealing cover having been moved aside leaving the tub under the faucets, which are attached to a water-pipe through the stationary dresser-top. At right, the three parts of the device are united and an ordinary piece of furniture is the result



A traction wheel and shoe to prevent lateral skidding

Combined Brake and Non-Skid Device for Automobiles

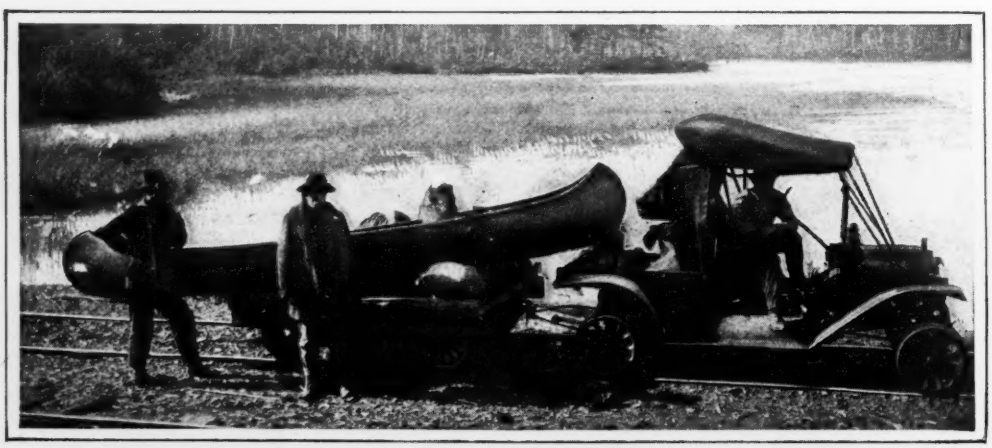
SUPPLEMENTING the action of the brakes and of deformed-tread tires on automobiles to prevent skidding, the non-skid device shown in the accompanying sketches is designed to prevent side or lateral skidding and to check the speed of the vehicle to avoid collisions which might occur if the side-skid apparatus alone were used. The mechanism consists of two independent parts, a traction-wheel for preventing lateral skidding and a shoe for decreasing the vehicle speed, both parts being forced into contact with the road surface by means of a chain and pedal and a wire and lever controlled from the driver's seat.

Light Railroading Accomplished by Automobile

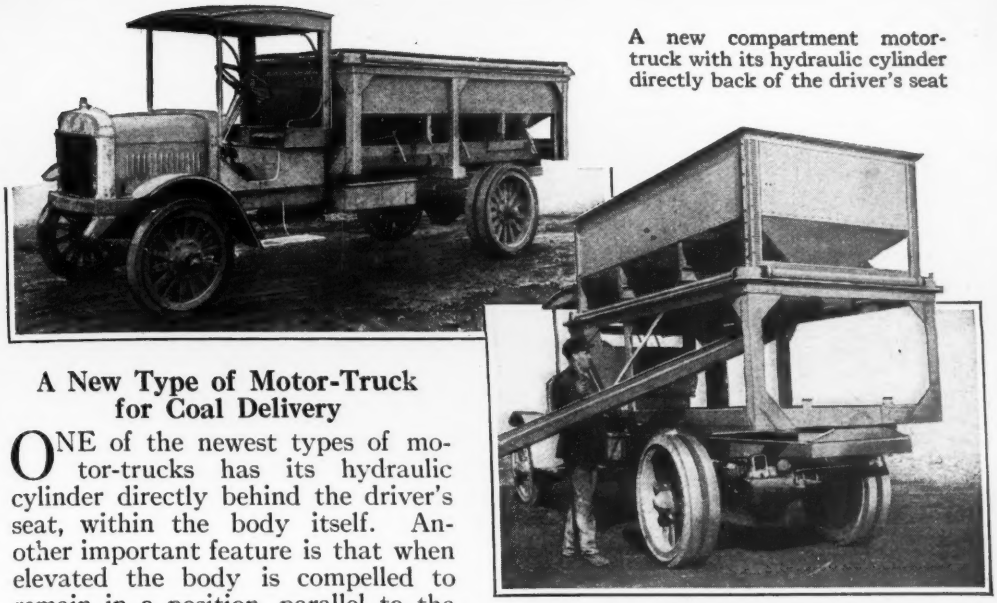
IN England motor car railways are fairly common especially where short, light, frequent hauls are the rule and in the United States there is many a suburban line with its self-propelled single passenger coaches. But probably nowhere will you find such a curious automobile railroad as the one running into Basswood Lake in the northern forest region of Minnesota.

This remarkable little railway system consists of a converted automobile, or "Lizzie," as it is known to many people. As seen in the accompanying illustration the automobile has been fitted with railroad wheels, instead of the usual tired wheels and hauls an abbreviated flat car. It was used on an abandoned logging road making connection with the Duluth and Iron Range Railroad.

This little road is rich in suggestion to others who may have minor traffic problems in remote regions. A second-hand automobile which could be purchased for a comparatively small price would lend itself to the purpose.



The railway system consists of a second-hand automobile provided with railroad wheels, which hauls an abbreviated flat car loaded with freight over an old logging road



A new compartment motor-truck with its hydraulic cylinder directly back of the driver's seat

A New Type of Motor-Truck for Coal Delivery

ONE of the newest types of motor-trucks has its hydraulic cylinder directly behind the driver's seat, within the body itself. Another important feature is that when elevated the body is compelled to remain in a position parallel to the truck frame, even with one end empty and the other loaded.

The body is straight-sided and divided into three or more compartments, each with a cone-shaped bottom provided with sliding doors. The body telescopes within a steel framework mounted on the truck frame, and when down the body is flush with the top of the framework. When it is forced up by means of the hydraulic cylinder in the center, it is kept parallel to the truck frame by means of eight racks, two at each corner, which mesh with eight rack-pinions on four shafts on top of the framework.

The bolts which hold the wheel to the rear fork stem-ends fit on a pair of collars on which the power plant is pivoted

Another Addition to the Motor-Bicycle Family

THE latest development in the motor-bicycle is the perfection of a motor-wheel which may be attached to any bicycle, whether it be a man's, a woman's or a juvenile model. The attachment consists of a heavy twenty-six-inch bicycle wheel incorporating a two-horsepower plant and fitted with a substantial mudguard designed to fit into the forks of any bicycle after the original wheel has been removed.

Although the wheel has a motor which has power enough to climb the steepest grades, the weight and vibration are taken up not by the bicycle itself but by the specially constructed wheel. The bicycle is really converted into a spring-frame machine. The motor is placed on the left side of the wheel in such a manner that it comes outside the rear fork stay of the bicycle when the wheel is in position. The crankshaft extends straight through the hub of the wheel and is mounted on the other extremity. A high-tension magneto is built into the flywheel. The position of the crankshaft is the novel feature of the device.

The Latest Automobile Improvements Include

A trunk for the automobile running board. It has four suitcases which fit snugly inside

At left: A pneumatic tire casing combined with a solid truck tread is solid yet resilient

At right: A new spark plug which gives an infinite number of sparks. Above appears method of sparking

A trained chicken which jumps up on the bumper every time the car is taken out. She made one trip of 264 miles, going 30 miles an hour

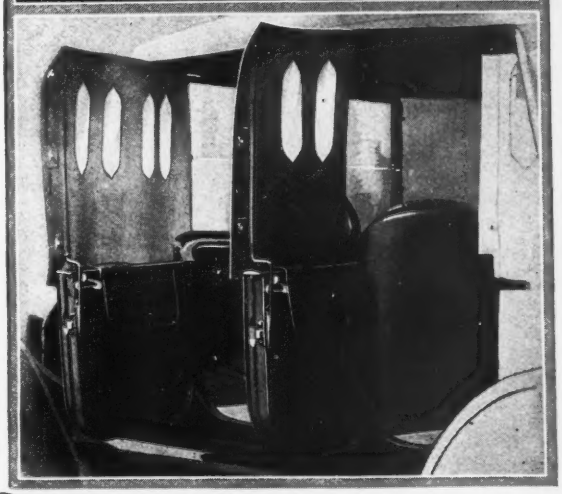
A herculean job for the motor-truck—moving an immense silo. Note the extended wheelbase

a Greater Working Capacity for the Truck

Above: A tire pump that works by foot-power instead of by hand-power. Press the foot down and the tire is inflated

Although heavily loaded itself this truck pulled a ship to its launching place with ease. A special trailer carries the ship

To the right: A mirror attachment by daylight and a searchlight at night. The mirror is attached to the searchlight casing



Below: A steering-wheel muff for protecting the hands in cold weather. It has two openings and is easily attached or detached

A new side-curtain equipment which opens with the doors. It enables passengers to get in and out of the car without bending over or unfastening the curtains when they are in use

Man's Invisible Friends and Foes

They were no more created to do us harm than were other forms of plant or animal life. If they had their choice they would never enter our bodies at all

By R. L. Kahn

WE and the bacteria are close neighbors. Our homes are their homes and wherever we go, they go. But alas! How we misunderstand their purpose.

Not long ago, I heard a lecture on these neighbors of ours. The speaker discussed a number of diseases in which bacteria play a part. I do not recall the details, but the impression left I remember well. It was that bacteria are our worst enemies.

It is well to emphasize the relation of bacteria to disease, but it is important that their relation to health be emphasized also. Their purpose seems to be not to cause disease and death but life and health. Remove bacteria from the world, and life might soon cease. Let them stop work, and plants and animals might starve to death.

Perhaps no other organisms play a more important role in the evolution of plant and animal life than bacteria. It seems truly inconceivable that organisms so minute should be capable of bringing about such profound changes in every phase of life. Tasks which the greatest chemists cannot perform they carry out with ease.

What Bacteria Do for the Farmer

The study of modern agriculture is largely the study of the bacteria of the soil. Decaying organic matter in the soil is transformed into food for plants by bacteria. Three types of these organisms supply plants with nitrates. One type transforms organic matter into ammonia, another changes the ammonia into nitrites and still another changes the nitrites into nitrates. Such is the division of labor that each kind of bacteria attends to its own specialty.

One of the products of decay is a gas-sulphuretted hydrogen. The sulphur bacteria decompose this gas and store up free sulphur in their own bodies. But the supply of sulphuretted hydrogen is soon exhausted. The bacteria perish and free sulphur is liberated. Ultimately we get sulphate of lime, an important constituent of plant food. There are also bacteria which supply plants with iron, and countless others which help in one way or another to make plant life possible.

If it were not for bacteria, the world might be piled up with dead plants and animals. Bacteria are the scavengers of the living world. As soon as the life of an animal or plant ends, bacteria gather around it, take the body apart, and reduce it to the elements of which it was originally built.

This inherent power makes bacteria perpetuators of life. Matter, we know, is indestructible. The elements which go to build up an animal or plant are not in any way affected when the animal or plant dies. Let these elements be set free, and Nature will utilize them for the construction of other living bodies. To bacteria it is given to supply Nature continually with elements so that she may always build new living structures.

Are Bacteria Necessary to Health?

Whether or not health is possible without bacteria is to-day one of the most interesting problems in the field of biological science. The question is far from settled. Nuttal and Thierfelder, two well-known scientists, believe that it is possible for animals to live and retain their health with sterilized air, food and water. Some famous experiments carried out by Cohendy and Wollman at the Pasteur Institute, Paris, also seem to indicate that animals

can live under sterile conditions, i.e., in an environment entirely free from bacteria. There are, on the other hand, a number of investigators who believe that bacteria are necessary to the development and health of animals. Madame Metchnikoff studied the development of tadpoles, some of which she kept under sterile conditions, while others she allowed to develop as they do in Nature. After a certain time, she found that those which she kept under ordinary conditions of life weighed six times as much as those which she kept under sterile conditions, which apparently proves that tadpoles can not enjoy the best health without bacteria.

In recent years, bacteria have also been used as curative agents. Metchnikoff's *Bulgaricus bacilli*, when taken internally, prevent the propagation of harmful bacteria in the intestines. The bacteria which cause intestinal putrefaction can thrive only in an alkaline medium. The *Bulgaricus bacilli* are acid-producing bacteria. Their

Above: A view of the entire apparatus devised by Professor Michel Cohendy for experiments on animal life in a sterile, bacteria-proof environment

At right: A chick that has served in the experiments. The chicks kept under absolutely sterile conditions lost twenty percent of their weight in five days

Below: Placing the sterilized eggs in the germ-proof incubator where the chicks for development under absolutely sterile conditions are hatched

acid makes conditions unfavorable for putrefaction. Hence the putrefaction bacteria ultimately perish.

How Bacteria Develop by the Million

Bacteria themselves, we must remember, do not know the importance of the position they occupy in the economy of life. All they care for is a warm place and a square meal for themselves and their young. And the young multiply rather fast. An average bacterium will divide in two in fifteen minutes; in half an hour there will be four, and in an hour as many as sixteen will be clamoring for food. The number of offspring at the end of a few days, if not checked, runs into billions. Add to this the fact that there are countless varieties of bacteria, because of the many different functions they have to perform and that these are present wherever there is plant or animal life, and we can appreciate how infinitely large are their numbers.

But of all the bacteria which surround us, only those few can do us harm which grow in the body tissues and enjoy a meal at the body's expense. Some of these will, from time to time, work their way into the tissues through a cut surface. In ninety-nine per cent of cases, these will not disturb our bodies in the slightest degree. The body fluids take care of them so quietly and effectively that we are not aware that harmful bacteria have paid us a visit.

Should, however, unusually large numbers of bacteria enter our bodies, and what is more important, should our resistance be at a low level, due perhaps to overwork or worry, they are likely to cause considerable disturbance. But many years of contact with bacteria have adjusted our bodies so that they can overcome these organisms with comparative ease, even after numbers of them have gained entrance.

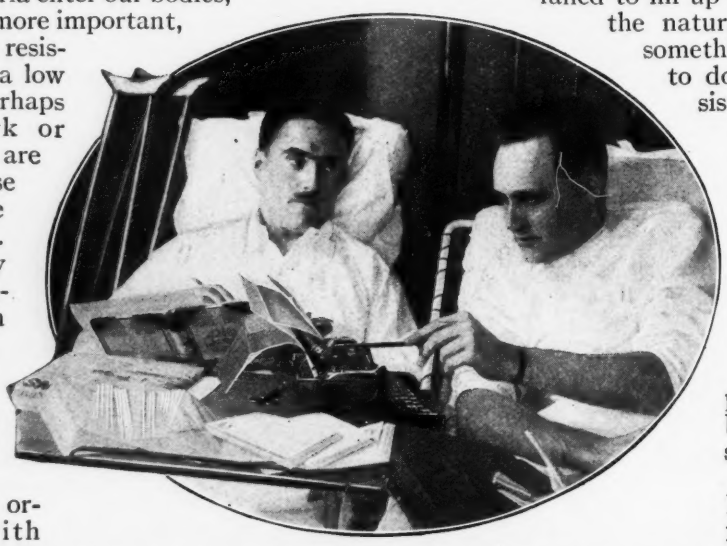
The entrance of these enemies causes the body to mobilize at once its defensive forces. Blood, lymph and white blood cells are sent to the spot where the bacteria entered, and because of this accumulation of fluids, that part is inflamed. The body often builds a wall around the infected area to prevent the bacteria from spreading to the surrounding tissues. The white cells now proceed to digest the bacteria. In the course of this process, they digest also the tissue which the bacteria fed upon and thus rendered useless to the body. The infected area—bacteria and all—now begins to soften. Pus, which is the product of this digestion, consisting mainly of digested tissue, dead bacteria and also dead white cells which gave their lives in this encounter, is formed. In a short while, the infected area is clean and healed. Thus the harmful bacteria are invariably routed from normal bodies.

Conducting a Thriving Business from Hospital Beds

TWO young men, H. K. De Prez, of Shelbyville, Ind., and E. L. Smith, of Montreal, met over the telephone in Mercy Hospital, in Chicago. Both had been athletes and had received injuries in sports. A friendship began and the young men arranged to occupy the same room in the hospital for the sake of companionship.

As their health improved games of chess failed to fill up their days and the natural craving for something worth while to do became irresistible. As a result the firm of De Prez and Smith, Magazine Agency, was formed. Typewriters were installed at their bedsides and a profitable business was started.

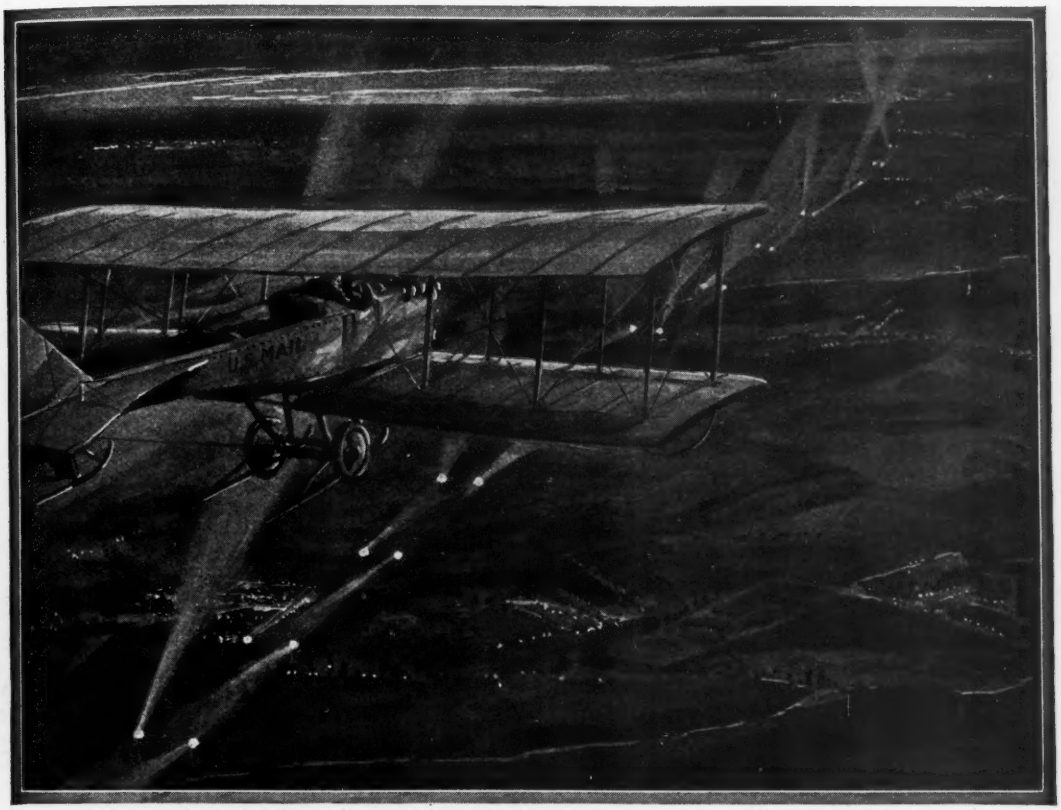
They sell POPULAR SCIENCE MONTHLY and other magazines.



From their hospital beds the young men conduct a magazine agency with branches in two cities and do their own advertising

Night Mail: A Flying Dream to be Realized

A letter mailed in New York at night will reach Chicago the next morning



If searchlights of about eight thousand candlepower equipped with acetylene gas tanks were used at each emergency station, the pilot would not be likely to lose his way

THE day is not far distant when you may drop a letter down the chute in New York and be confident of its delivery in Chicago the next morning.

The flights of Ruth Law and Victor Carlstrom have afforded ample proof that a New York-Chicago mail service by aeroplane is feasible. The Post Office Department is actually considering an air-line mail-service between the two cities. It is estimated that the trips can be made in from six to fourteen hours, depending upon the wind, and that the average flying time for the seven hundred and twenty miles will be eight hours. The distance by rail is about one thousand miles.

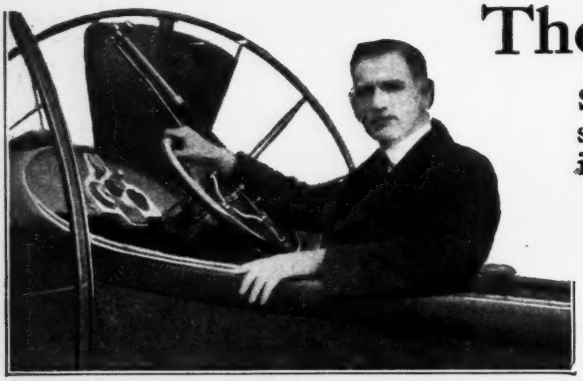
Definite plans for the maintenance on a regular schedule of this air trunk-line for the mail have been proposed. One plan involves emergency stations every twenty-two miles, each equipped with powerful lights. In addition, two landing and one relay station are also planned. The aeroplanes would leave the two termini at six o'clock in the evening and deliver the mail before nine o'clock the following morning. Under the most favorable conditions it would reach Chicago by midnight.

Leaving New York at dusk, the aeroplane mail-carrier would follow the lights at the emergency stations to the first landing station, which would be in the vicinity of Williamsport, Pa. There, at a flying field equipped with hangars, tools and spare parts, he would stop for oil and gasoline, and would then continue to a relay station near Niles, Ohio. Here another machine would finish the flight, landing near Napoleon, Ohio. Powerful searchlights would mark the emergeney stations and special lighting systems would illuminate the flying fields, even in foggy weather.

The Motor Goose

She runs on the ground; she swims in water; and her inventor says she will fly

By Carl Dienstbach

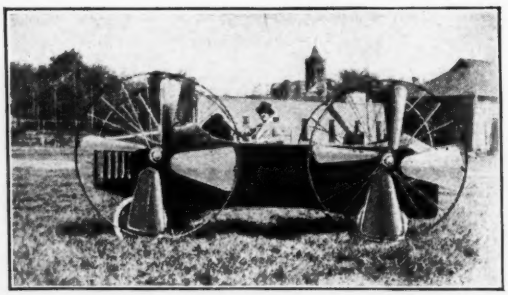


William A. Sharpe in his motor goose which is a combination automobile, motor boat and flying machine

BEFORE an aeroplane can fly, it must be in motion. Therefore a preliminary run upon the ground is necessary. Hence, every aeroplane is virtually an automobile and could be used as such if our roads were wide enough to accommodate its wings. A hydroaeroplane is a flying machine which takes its running start on water. Hence, it must be a serviceable water craft. Is it not possible to build a machine which will be automobile, motor boat and flying machine in one? William A. Sharpe, of Detroit, thinks so.

It is not a new idea to build a floatable automobile which can run into a river from the shore without a stop. But it is certainly a new idea to combine in one vehicle the properties of an automobile, a motor boat and a flying machine.

Mr. Sharpe's vehicle has a boat body which is mounted on regulation automobile wheels, which is equipped with a rudder, and which is propelled by four air propellers. These air propellers are in reality feathering paddle-wheels such as have been often proposed for air craft. Benbow used them on the dirigible with which he flew over the St. Louis World's Fair in 1904, for example.



There are no supporting surfaces, such as wings. The machine would mount into the air by the helicopter, or screw-flyer, principle

The ordinary air propeller is usually mounted on an aeroplane at the rear or in front. Mr. Sharpe would mount his propellers as the paddle-wheels of river steamers are mounted—that is, flat along the sides of the craft. In that position they undoubtedly take up much less room than ordinary aeroplane propellers. By a simple adjustment of the mechanism that controls the feathering, they can be made either to lift or propel, or perform both functions to a varying degree. To maintain the balance of the craft in flight, seems theoretically easy; for the lift at each of the four supporting points may be increased or reduced at will as the occasion may demand.

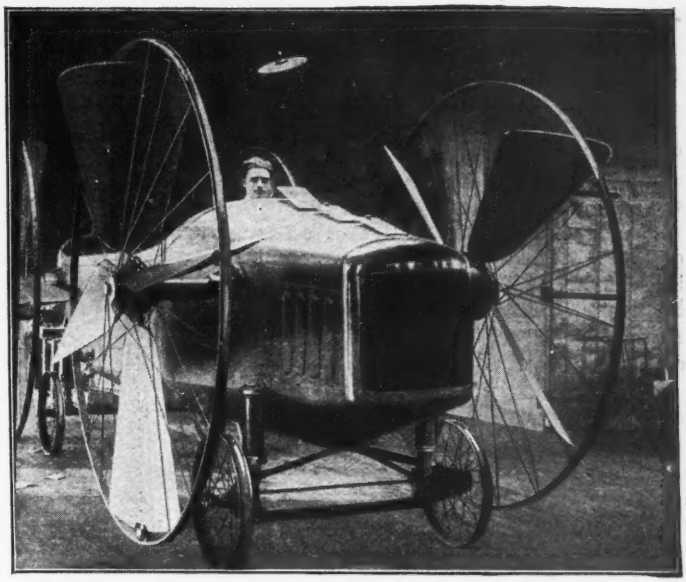
As the boat, automobile, or flying machine, whatever it may be called, is driven over roads or water, the lifting effect of the propellers would undoubtedly be conducive to high speed. But, can the propellers support a machine in the air? If you will study the accompanying photographs you will see that no supporting surfaces, such as wings, are provided. How then can the machine fly?

Perhaps you have seen a little toy which consists essentially of a horizontally mounted screw-propeller driven by a rubber band. When you tighten up the rubber band and release it, the propeller literally kicks the little toy up into the air. Such a machine is known as a helicopter, or screw-flyer. No helicopter has ever been built bigger than this little toy—that is, a helicopter that will fly.

Mr. Sharpe intends to rely upon the helicopter principle in order to get his machine into the air. Unfortunately, his propellers are smaller than those of a helicopter's of equal size. Even if they were of the right size and even if they were mounted horizontally like those of a true helicopter, it is doubtful if he would get off the ground. Only one of the blades of his propellers is effective at a time, just like the paddles of a river steamer. To get a substantial lifting grip

on the air, the propellers would have to be very strong and the motor by which they would be driven would have to be very light. Their speeds would necessarily be enormous. How much additional support the propellers might gain gratuitously by moving ahead and always working in fresh undisturbed air, has never been discovered. Too little is known of helicopters to settle the matter.

At very high speeds flywheels often burst because of the enormous centrifugal force developed. At the high speed with which Mr. Sharpe would have to run his propellers in order to get into the air, equally great centrifugal force would be generated, particularly if all the delicate feathering mechanism must be exposed to them. Lastly it is to be noted that the front paddle-wheels leave a wake which must be disturbing to the rear pair.



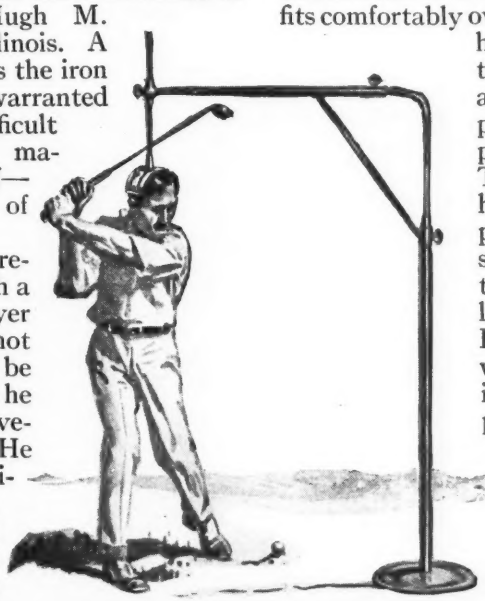
A close-up view of the proposed machine. The propellers would have to be very strong and the motor light to lift it

Let This Machine Teach You How to Play Golf

DID you ever see a golf coach made of iron rods, a few screws, and a leather pad? If not, look upon the illustration of one invented by Hugh M. Rhind, of Chicago, Illinois. A perfectly good coach is the iron contrivance; for it is warranted to teach the most difficult and most important maneuver in playing golf—the perfect "driving" of the ball.

The secret of the remarkable way in which a real good golf player drives one "great" shot after another is to be found in the fact that he performs the same movements for all drives. He has found from experience that, for instance, by keeping his head stationary until the ball is driven from the tee, and by keeping his arms at a certain definite extension and level, he will hit the ball efficiently. Evidently then, it will be necessary for him only to repeat exactly these same movements, and the next time he will make the same wondrous shot, to the great amazement of the onlookers.

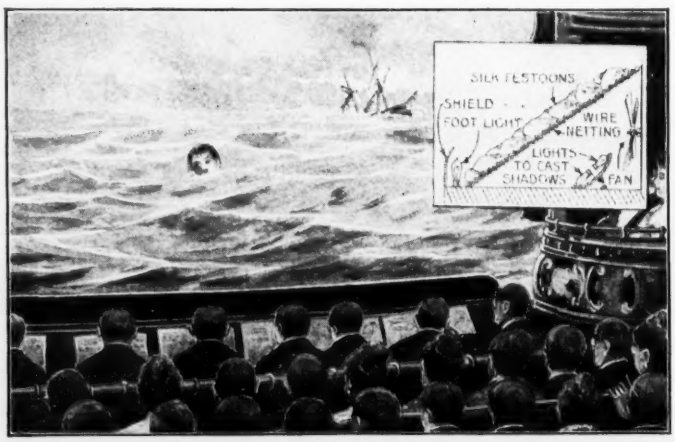
It is on just this simple principle that Rhind's invention works. It teaches a man to keep his head still during the downstroke of the drive. The leather pad fits comfortably over one side of the player's head. The iron rods hold the pad firmly in place, and the screws allow the pad to be adjusted to fit persons of various heights. The player-to-be plants his head firmly against the pad, and not until he has struck the ball from the tee does he remove it to lunge his body forward. His head and shoulders will then have been kept in the exact position for a perfect sight and a good stroke. After the beginner has studiously practiced with this devise for several successive rounds of the links, he will be far on his way towards becoming a star in the sport.



The device keeps the golf player's head and shoulders level in order that a correct sight may be readily obtained

Making a Stage Ocean with Green Silk and an Electric Fan

ATTEMPTS made to devise apparatus by which the effect of a heavy sea can be obtained on the stage without actually employing water have been somewhat unsuccessful. Ordinarily a large canvas is employed, painted to represent waves and moved by machine or by hand beneath the canvas. Stereopticon pictures and colored lights have been utilized to make the effects more realistic. All these attempts have not only been expensive and cumbersome but have proved unsatisfactory. They lacked realism.



Festoons of light-weight silk, sea-green in color, are supported by wire netting and waved by the air currents from the fan

Ida May Fuller, of New York city, has obtained satisfactory results on the stage by means of an openwork support, preferably of light, white netting, to which is attached in festoons on the front side a fabric such as a fine translucent silk, which reflects light and which is of such texture as to be easily waved back and forth by an electric fan or by hand.

Water-green colored silk produces a satisfactory illusion, without any external lighting effects, regardless of whether the motion of the waves is made by stage hands moving the support or whether an electric fan is used. When it is desired to show figures or objects beneath the water the figures are placed beneath the projecting light and behind the support.

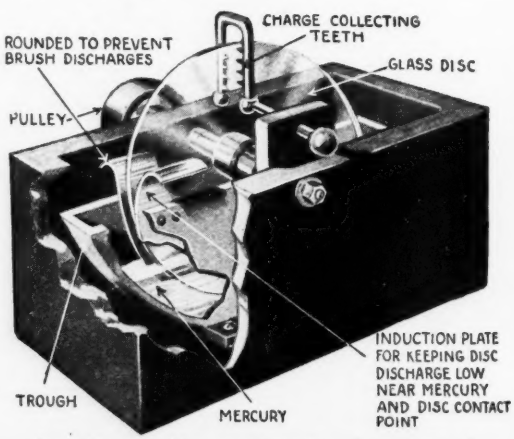
A Frictionless Contact Generator of Static Electricity

WHEN two dissimilar substances are pressed together and then separated, one acquires a positive charge and the other a negative charge. A leather belt running on an iron pulley is an illustration of this. The belt acquires a negative charge at the point of separation from the pulley and the pulley a positive charge.

Hitherto, with static generators, a moving plate of glass with frictional rubbers attached has been employed to generate the electricity. William H. Chapman, of Portland, Maine, applies the contact principle of the iron pulley and belt instead of the principle of friction in static generators.

In his machine the usual friction pads give place to a trough of mercury, analogous to the iron pulley. Not only is an unprecedented mechanical efficiency obtained but from an electrical standpoint the high potential effects are of an order not heretofore attainable with friction apparatus.

A glass plate eight inches in diameter, making eighty complete revolutions a minute and dipping into a mercury trough to a depth of one and one half inches, without induction plates, will develop a potential of 9,000 volts on comb points, arranged to collect the charge at the top of the plate. The application of induction plates close to the revolving plate, at the point where it leaves the mercury, raises the potential to 13,000 volts or more on the comb points and gives sparks three-quarter inch long. This is still further increased by covering the induction plates with a thin sheet of rubber or glass.



In this machine a trough of mercury is employed to generate electricity by contact

Making a Fortune out of Tears

The Story of a Child's Toy

By Harold Cary

IN 1904 Clarence White, of North Bennington, Vermont, was doing a large business in stereoscopic photographs and stereoscopes. He had more than four hundred agents on his list. Sales amounted to about half a million a year. Business was so good that a hundred thousand dollar-addition to the factory was made. Then, in 1905 the motion picture came. The stereoscopic photograph industry collapsed. Said the boys of the country: "Why should we look at stereoscopes when we can see motion pictures?"

The construction of the little cart is simplicity itself, but it pleases the youngsters, so the production is rapidly approaching thirty-five hundred a day

Clarence White started to hunt for something new to manufacture. Toys of various sorts were tried out. They had a good sale only during the months preceding Christmas.

Discouraging conditions continued until 1915. In the Spring of that year Clarence White came home one day to find his two and a half-year old son in tears and his mother discouraged. The youngster insisted on riding his toy cast-iron fire-department equipment to destruction. He had already smashed the hose cart. The tears were caused by his mother's refusal to allow him to break down the fire engine too.

"Never mind," said father. "I'll build you something that you can't break."

The next night Clarence White brought home a little three wheeled cart made of a board, an upright handle and wooden circles cut from another board.

But the trouble had only begun. The youngster who lived next door had seen the cart and coveted it in the Biblical way, which means that he took it. The neighbor's wife brought it back in the evening and made the White boy happy again, but she explained also that her Crown Prince would be uncontrollable until he had one like it. He got his cart, too. So did half a dozen other youngsters who lived nearby. A home demand was created. White began to work at the problem of giving the boys of the nation carts like those he had made for Bennington.

He took out patents and made a dozen carts to be tried out as samples in New York. These were placed on the floor in a New York department store. While they were being unpacked one Saturday, a woman from Plainfield, New Jersey, saw them and carried one home. On the following Monday morning half a dozen Plainfield mothers trooped in for carts like the one they had seen. The entire shipment was sold during the day and the toy buyer put in an order for ten gross.

Bennington was on its industrial feet again. Mr. White's father is a splendid old-time mechanic. To him was entrusted the task of providing machines that would turn out the little carts automatically. In a few months the output had risen to fifteen hundred carts a day. At no time has production caught up with demand. The first profits, amounting to one hundred and twenty-five thousand dollars, were put back in the business to buy machines. On September 4, 1916, production had increased to twenty-five hundred a day.

The tank holds nearly two thousand gallons of water and is designed to withstand a pressure of forty-two pounds to the square inch. On account of the high pressure less water is needed

New York's Wonderful Street-Sweeper and High-Pressure Flusher

THE New York city street cleaning department, tired of waiting for inventors to turn out an efficient cleaning machine, put its own electrical and mechanical engineers to work on designs.

The new cleaner they devised is almost completely electric. Every wheel is turned by motor power. The current is generated by a dynamo which is driven by the gasoline engine under the hood. Two motors turn the driving wheels, one the broom, another the atomizer pump and a third the flushing pump.

The driver of the truck handles his gasoline engine and steers the machine, all other work being done by the flusher who has a seat on the rear of the trailer, at which point all the controllers for the various devices are located.

The machine is capable of cleaning from one hundred to one hundred and twenty-five thousand square yards of paving per day. It can scrub a street which is thirty feet from curb to curb in two trips. As it moves at a speed of from nine to nine and a half miles an hour it can clean fifty miles of street in a single ten-hour night.

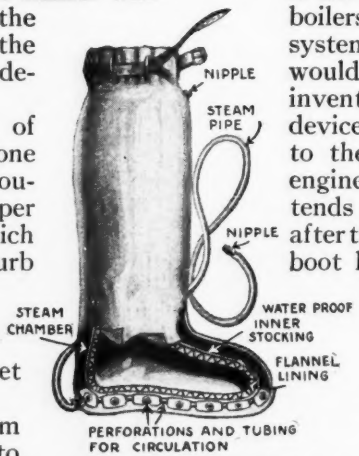
Utilizing the pressure system of flushing makes it possible to clean the streets as carefully as a ball room floor. The tank holds 1675 gallons of water.

Your Feet Are Cold? Then Use the Foot-Radiator

FROM West Virginia comes a new application for hot-water and steam heating. The inventor has designed a boot on the style of a foot-radiator. It consists of an inner water-tight stocking of rubber and another stocking surrounding it. The space between the two is sealed from the outside except for two openings, one through which hot water or steam is to be supplied to fill the opening, and the other through which the cooled water and the used steam are to be ejected.

There are two ways of supplying the hot water or steam. One is to attach a hose to each opening and connect it with a source of hot water in the same way that boilers are connected in a heating system; the other is to fill it as you would a hot water bottle. The inventor makes the claim that the device may be used by attaching it to the exhaust of an automobile engine. Just how the inventor intends to carry off the exhaust gases after they have been admitted to the boot he does not say. Evidently the thought in his mind was to provide an outlet for the purpose on the outer side of the boot, or through the ejector hose.

Some kind of a control arrangement would have to be provided, also, to prevent the boot from becoming uncomfortably hot.



The radiator boot is connected to a hot water supply in the same way as is a steam radiator

The Way of a Bird in the Air

A gigantic artificial dove and the lesson that it teaches

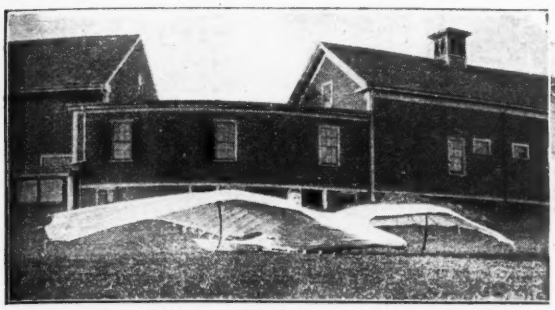
MORE than twenty years ago, Otto Lillienthal, a German engineer, became interested in flying. He was one of the first scientific pioneers of the aeroplane. For weeks and weeks at a time, he would watch storks in motion. To him, birds were masters from whom ignorant man must learn if he, too, would fly.

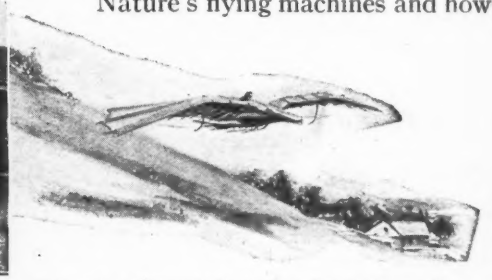
Lillienthal's first step, after long watching was to build a motor-less machine of a type which has since come to be called a glider, a kind of artificial bird, consisting primarily of a pair of canvas wings stretched on a frame. He would run down a hill with this apparatus. After he had acquired sufficient momentum, he would draw up his legs, glide along freely for perhaps a hundred yards, and come to earth.

This performance was not so easy as it seems. Even on the calmest days, the wind tended to upset his apparatus. Lillienthal had to throw himself bodily from side to side to maintain his balance. He had to be very quick—just as quick as the wind. He made many hundred flights and learned a great deal about soaring. But one day, he was not quick enough. The wind upset him, and he was killed—one of the first martyrs of the air.

When the motor-driven aeroplane at last came, inventors paid less and less attention to birds. The construction of flying machines was reduced to a problem in engineering. And so the aeroplane became less and less bird-like. In the hands of Wright and Curtiss it assumed the form of a box-kite with a man and motor perched on the lower edge. Soon it was found that such a construction offered too much resistance to the air, and that, after all, the bird idea was inherently correct. All the latest machines look very much like birds because they have been provided with bird-like bodies in which passengers and engines are carried.

A New England inventor, Percival White, has very wisely taken up Lillienthal's line of investigation and has built an exact gigantic copy of a carrier pigeon. His glider is an object lesson. His huge bird shows how sweet are the lines of Nature's flying machines and how well worth copying they are. Although he may not have had it in mind, young White has vindicated Lillienthal. Every aeroplane designer must envy the modeling of White's glider.





Percival White's gigantic copy of a carrier pigeon. It has landing skids under the body and a drag post under each wing for easy alighting. The wings are pivoted and swing easily

Lillienthal took great pains to explain that if a bird is merely copied and enlarged, it becomes either too heavy or too weak to fly. This is a matter of structural size and strength. How White has made his artificial dove strong and light enough to serve as a gliding machine without prominent stay posts and wires remains a question. But even if White's glider serves no other purpose than that of setting the flying efficiency of a bird's shape into bold relief, it is worthy of all praise. Assuming that the structure is strong enough, the flat gliding angle and the perfect shape of the body would insure efficient flight. Like Lillienthal, White must throw his body from side to side in order to balance himself. But balancing in this fashion ought to be easy for White. Lillienthal himself pointed out that a bird easily shifts its weight or rather muscular effort (the same thing in this instance) to both wings or fore and aft in order to control itself sidewise and lengthwise.—CARL DIENSTBACH.

Hell Swazey Breaks up the Dance

A true dynamite story which shows how an important fact about nitro-glycerine was discovered

By Hudson Maxim

This story, which tells how the fact that nitro-glycerine can be made safe simply by freezing it was discovered, is taken from Hudson Maxim's recently published "Dynamite Stories." The author's impression of Popular Science Monthly is printed on page 321. He is the inventor of the smokeless powder used in the navy, one of the foremost authorities on explosives in the world, a distinguished inventor, and a prominent member of the Naval Consulting Board.—EDITOR.

ABOUT the first use of nitro-glycerine in the United States as a blasting agent on a large scale was in the construction of the Hoosac Tunnel in Massachusetts, on the Boston and Albany Railroad.

A chemist by the name of Professor Mowbray believed that the main trouble with nitro-glycerine had been that it was not sufficiently purified in its manufacture. He induced the builders of the Hoosac Tunnel to try his product.

He put it up in tin cans, which held about a quart. For transportation these were carefully packed in cotton flannel.

The method of using the dynamite was to pour it into holes drilled in the rock, inserting an exploder cap and fuse in the usual manner. At that time it was popularly supposed that if nitro-glycerine or dynamite were allowed to freeze, it became very highly sensitive and would explode on the slightest jar. Stories were prevalent that the sound of a fiddle would explode it.

One day there came an urgent call from the east end of the Tunnel for more nitro-glycerine. Professor Mowbray had in his employ a care-free and fear-free fellow by the name of Helton Swazey. When Swazey was sober, he was the soul of good nature, but when drunk, which was very frequently, he was as savage as a hungry cougar. This peculiarity earned Helton Swazey the nickname of Hell Swazey.

It was a very cold winter day when the call came, and Professor Mowbray, learning that Hell Swazey was going over the mountain that very evening to attend a dance, asked him if he would not take over the nitro-glycerine with him. A hot-water bag was placed with the nitro-glycerine and all was wrapped in a heavy blanket to protect it from Jack Frost. The shipment was placed in the back of Swazey's sleigh.

His best girl, whom he took with him, did not know the nature of the cargo.

The nine-mile ride over the mountain was very cold. Swazey kept himself warm by imbibitions from a flask of liquid caloric, and to keep the young woman warm he took the blanket and the hot-water bag from the nitro-glycerine for her comfort, leaving the explosive to the mercy of the below-zero weather.

When Swazey arrived at the dance-hall to join in the frolic, he was in so ugly and meddlesome a mood that he was promptly put out of the hall, followed by his woman companion. Swazey was mad all through. He went to the sleigh, and taking an armful of the cans of nitro-glycerine, returned to the hall. Opening the door he proceeded to hurl them at the merrymakers.

One can struck upon the stove and glanced across the room. Cans smashed against wall, ceiling and floor.

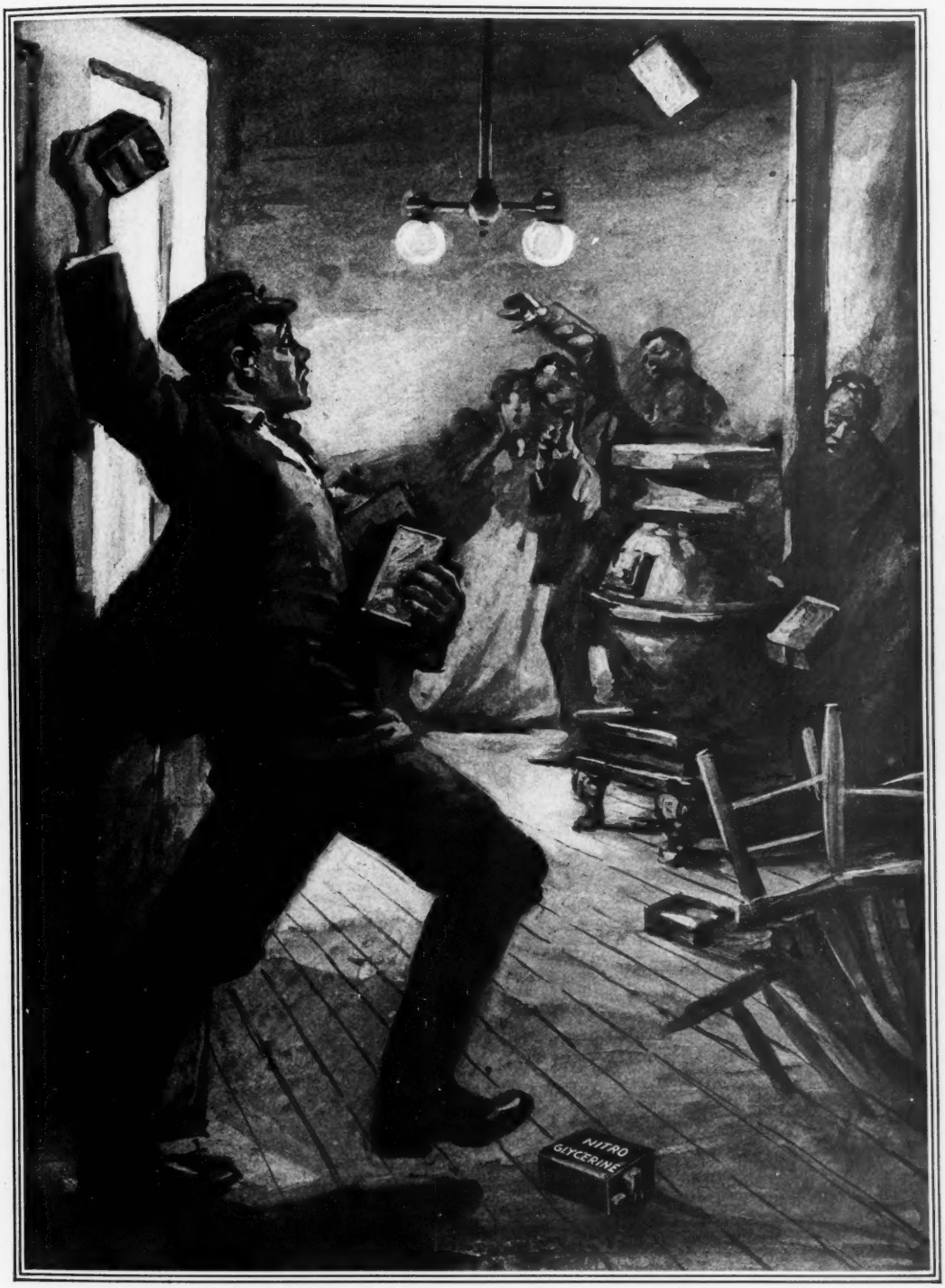
When Hell Swazey turned up for duty the next morning, Professor Mowbray had already heard of the escapade, but he was filled with marveling why the nitro-glycerine had not exploded, particularly as it must have been frozen very hard.

When Swazey entered the presence of the Professor, he expected to be discharged.

To his amazement, Professor Mowbray appeared to be very much interested and pleased, tapping his forehead with his finger, smiling and nodding and muttering to himself, "Good; good; splendid!" He interrogated Swazey carefully, to be assured that the nitro-glycerine was frozen hard, that it had been thrown hard, that it had struck hard, and that it had not exploded.

That very night there was mailed at the North Adams Post Office an application for a patent for freezing nitro-glycerine to make it safe to handle.

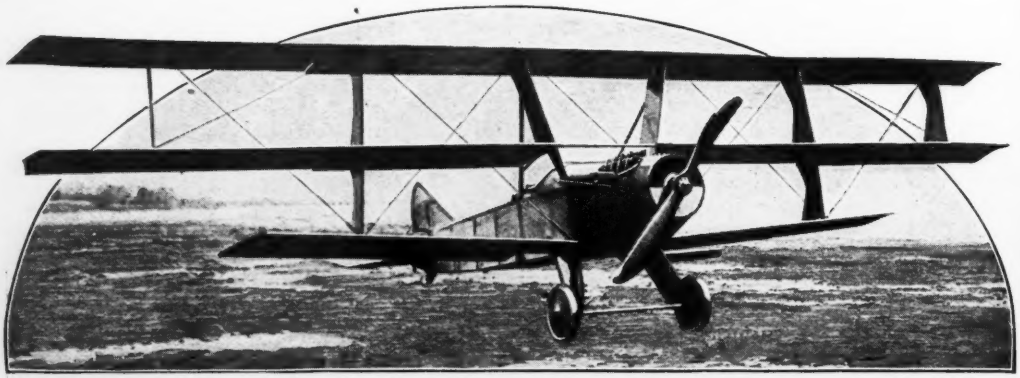
"Threw Me Out, Did Ye? Then Take That and That!"



When Swazey was sober he was the soul of good nature, but when he entered the dance-hall he had imbibed such a quantity of fiery spirits that he was as savage as a cougar. So they put him out. In the truck outside were the cans of nitro-glycerine—handy missiles with which to "get even." But kind Providence foiled the plan. The explosive was frozen

A Touring Triplane for Ruth Law

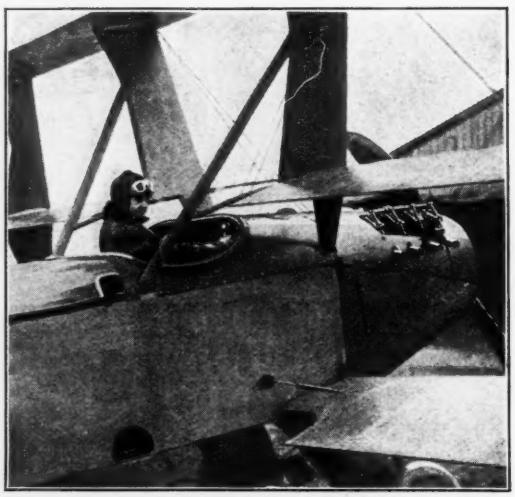
A new world's record is now in order



Wires are not entirely absent from the construction of the machine. But they are so few in number that their effect will be negligible. Resistance has been reduced by eliminating the rear struts

THE early builders of aeroplanes cared little for the resistance offered by the air. They were glad enough to fly at all. Wires and struts were used with no regard whatever for their retarding effect when propelled against the air at railway speed. The aviator sat on the lower edge of a biplane so that his body added its resistance to that of numerous projections. No wonder that monoplanes were swifter.

Soon aeroplane builders discovered what they should have known in the very first place—that it is easier to move a large, correctly designed bulk through the air than a multitude of projections each of which rakes the atmosphere and leaves a little wake of its own behind it. As a result the aviator, whether he mounts a monoplane or a biplane, is now completely enclosed in a kind of boat-body so shaped that it parts the air easily and leaves a comparatively quiet wake at the rear.



The boat body is so shaped that it parts the air easily and leaves a quiet wake behind

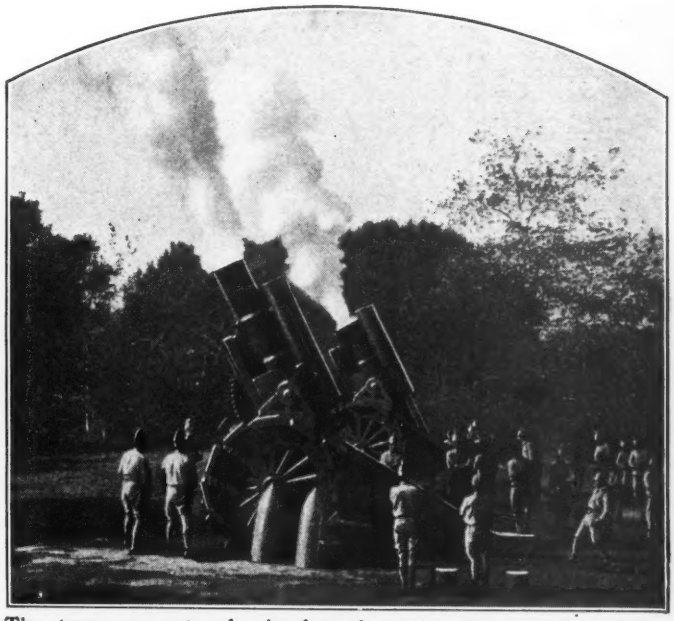
In the early days of the aeroplane, it was thought that the piling of surface on surface, while it meant stability in flying, also meant much head-resistance. It is true that the resistance is increased. But if structural difficulties are overcome, wire stays may be abandoned without at all weakening the craft. Recently a triplane without wire staying broke the speed record of monoplanes—an achievement which would have been considered impossible only five years ago. The performance of that triplane served to drive home the lesson that it is head-resistance which counts for everything in attaining speed. After that success it naturally followed that a touring triplane like that of Miss Law should be built.

Study the photographs of Miss Law's machine. Wires are not entirely absent. They are necessary because of the machine's size. Still they are so few in number that their effect must be almost negligible. The rear struts have disappeared with the result that useless resistance has been much reduced. Plucky Miss Law, who accomplished so much with an antiquated type in flying from Chicago to New York, should do great things in this modern machine.

Terrible to the Eye Alone

A boy's bean-shooter can do more harm than one of these stage guns, despite their formidable appearance

THE big Bertha and all the other members of the Krupp gun family stand a fair chance of being out-Krupped if our enthusiastic motion-picture producers continue to copy faithfully the outward appearance of Germany's modern ordnance. In one of our latest celluloid thrillers, depicting the capture and ruin of this country by an invading force, Krupp guns—or at least their wooden counterfeits—are utilized so realistically as to lead the audience to surmise that the Kaiser chartered a tug boat and scow to ship his Krupps over the sea for just one motion-picture play. The fact is that the office boy with his bean-shooter can do more damage than a dozen such "stage" guns.



The stage guns not only simulate the outward appearance of the Krupps but even their recoil movement at the moment of discharge

But for motion-picture purposes these wooden counterfeits are just as effective as the real article. To see them roll up some peaceful countryside followed by a horde of warriors and to see the big make-believe monsters boom away at an invisible enemy is just the next best thing to seeing one of the Crown Prince's armies batter away at the French. The effect is startlingly realistic.

The principle feature about these guns which makes them simulate the real Krupps, is their ability to imitate the natural recoil at the moment of discharge, and the gradual raising to firing position. Each gun is provided with mechanical means which give a realistic representation of a modern highpower gun in action. For instance, a powder charge is exploded to represent the discharge of the genuine gun. The charge is ignited by an electric circuit.

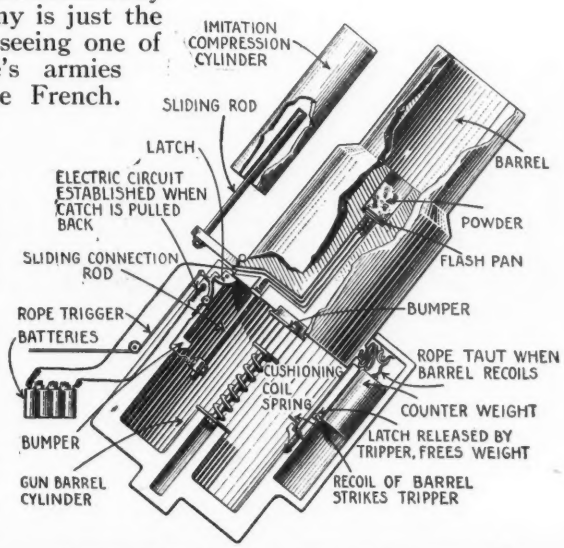
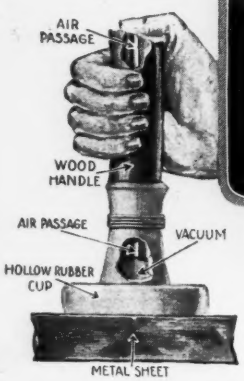


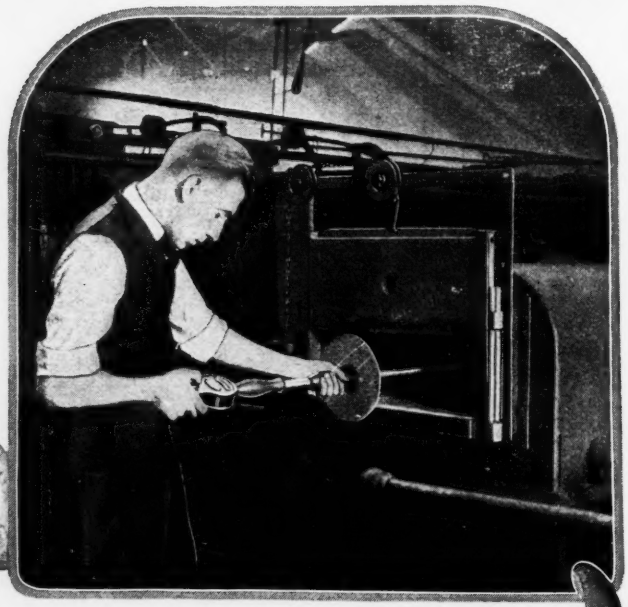
Diagram of the interior of the wooden gun. The charge of powder is ignited by an electric circuit

At the instant of powder discharge the gun barrel moves freely down in its frame. In its downward movement a spring is compressed, giving the cushioning effect of the compression cylinders of modern guns. The gun barrel weighs four hundred and fifty pounds. In order to move it back again to its original firing position a counterweight of five hundred pounds is released by a lever.

New Kinks and New Tools Which Have Been

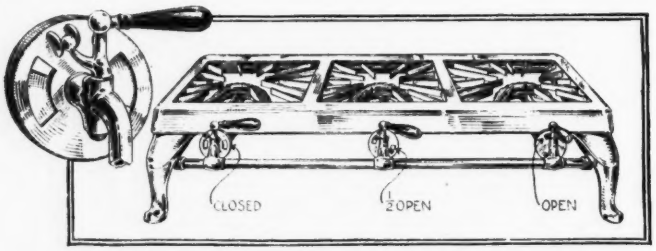
Below: The "sucker" principle utilized in gripping weights. After creating a vacuum the hollow rubber cups stick tightly to the weight



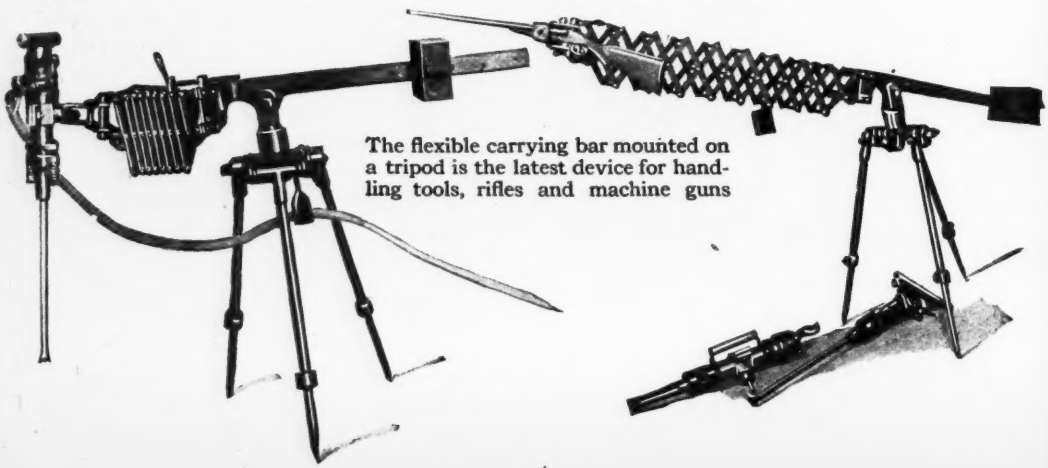


Feeling the pulse of steel with a hollow rod, on one end of which a meter is fitted to gage the temperature. When the dial needle touches a red mark the critical point has been reached

Below: A screwdriver which is pivoted to its handle. It can be used in the usual straight position or in the "T" position, as illustrated

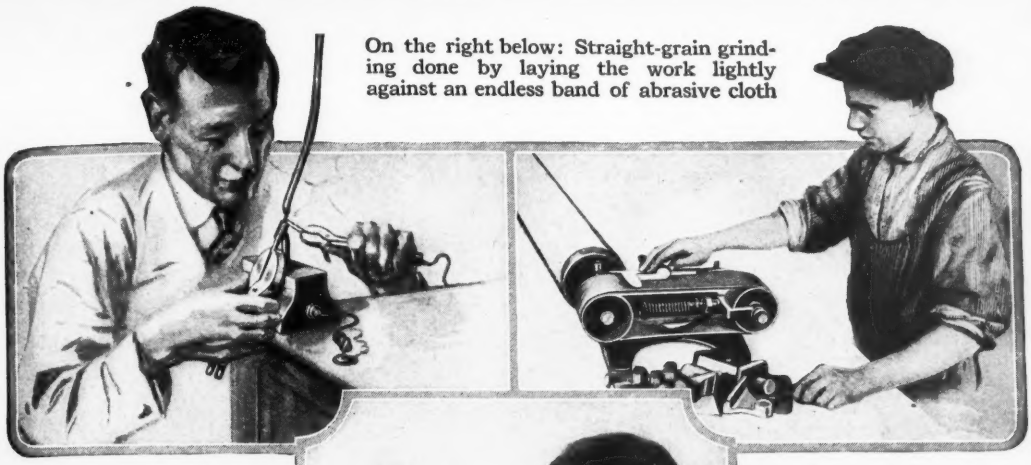


A valve and cock which not only controls the amount of gas but the amount of air feed to a stove



The flexible carrying bar mounted on a tripod is the latest device for handling tools, rifles and machine guns

Placed in the Hands of the Mechanical Workers



On the right below: Straight-grain grinding done by laying the work lightly against an endless band of abrasive cloth

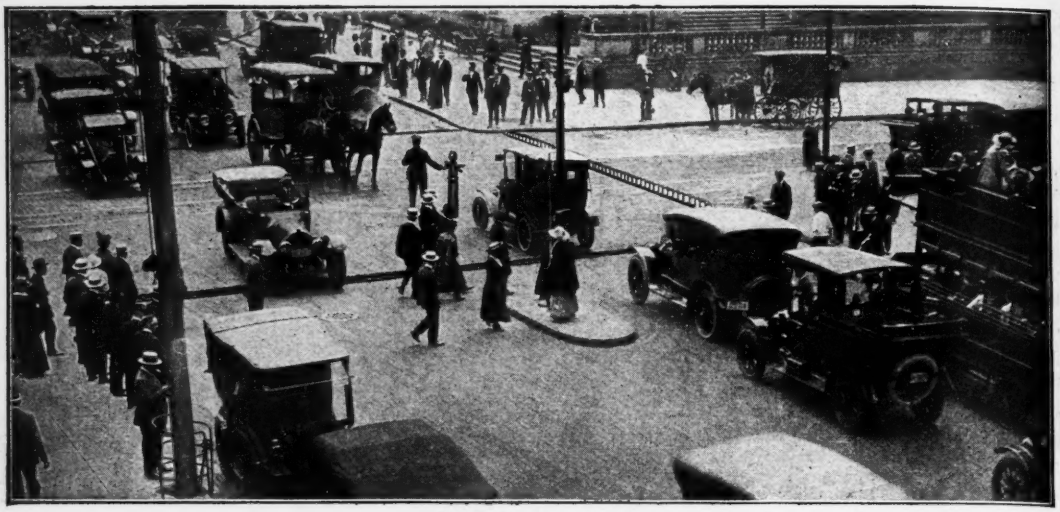
Above: A soldering apparatus in which the current employed passes through the solder being used. The circuit is broken when the solder is removed so that none is wasted

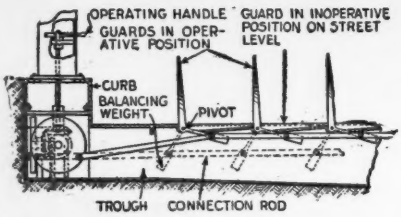
At left: A machine-tool which cuts duplicate keys from originals in a minute or less. The key to be duplicated is placed in the lower vise and the blank key in the upper vise

Below: Flexible sheet-metal belting made up of a series of sheets linked together. They are easily detached

Below: A tool which can be adjusted to cut round holes of various sizes. It is operated by a ratchet-wrench

A six-pronged rack which enables a man to elevate a barrel in three different positions for drawing the contents. It is also used in loading and unloading freight





At left is a diagram that explains the operative principle of the device. In the picture above the policeman at the central post in the middle of the street has thrown the apparatus into operation

The Automatic Traffic Controller. No Law-Breaking Speeder Can Escape It

ENERGETIC drivers who use the city streets for a race course would find their riding rather rough if the streets were fitted with John J. Keenan's traffic controller. It is guaranteed to stop in record time any driver who is trying to defy the speed laws.

The device, as the illustration shows, embodies a series of short steel arms which are fitted across a narrow trough in the ground. The arms, strung one after another across the corner of a street, connect at the bottom with a long bar. This bar can be worked back and forth within the trough by means of its gearing connection with a turnable upright post. Through this bar, the arms can be made to turn around until they project above the street when the post is swung around in one direction. When the post is swung in the opposite direction, on the other hand, the arms are turned downwardly until they are flush with the level of the street, thereby closing up the trough.

An elaborate electric signaling system connects each post with all the others that may be placed at the important points along the main highways. Should a party of autoists come tearing down the street, the policeman who first sees them signals ahead to other officers. They in turn throw the apparatus in operation. Unless the autoists heed the warning to stop, they will find that the projecting arms will have punctured a tire or two, or will have ripped off some of their mechanism. If the policeman should have deemed it necessary to telephone all the stations in the city to be thrown in, there would be little chance for anybody to get away.

Grafting with Frog's Skin Gives Satisfactory Results

THE idea of grafting with frog's skin was put into practice as early as 1886. Recently fourteen cases of successful grafting were reported in France. The ideal wound to graft is flat, and without excessive granulations.

The method of applying the frog's skin is as follows. The wound is first gently cleaned without antiseptics and as gently dried. Then the loose skin on the inner side of the frog's thigh is carefully pinched up in a pair of dressing forceps, snipped off with scissors, spread out and applied by its under surface to the wound. A strip of gutta-percha tissue is then placed over it and fixed in position at its ends by adhesive plaster. Then a dry dressing is applied over all. The wound heals with remarkable rapidity after the grafting. Frog's skin is used, however, only in places where it will not be conspicuous.

Loaned Mothers and Borrowed Offspring in the Animal World

IF the wolf that mothered Romulus and Remus had realized that the two little waifs belonged to the tribe of her enemy, man, and would doubtless grow up to kill thousands of wolves and probably herself, would she have nourished them and cared for them so faithfully?

Likewise the hen in the picture. She has taken under her wings a litter of pups and is as happy brooding over them as if they were a hatching of blue ribbon chicks. Yet those same puppies will in an inconceivably short time forget the warmth of the sheltering wings and tease and torment the hen to the limit of her endurance, kill her legitimate chicks and make life in general miserable for her unless a kind providence in the person of the farmer with a stick teaches them to do otherwise than they would if left to instinct.

The motherless pups and the chickenless hen are equally satisfied for the time being by the temporary adoption

The question which inevitably arises is "Does the mothering instinct put reason to flight?" In this case the answer might be that no one ever accused the hen of having reasoning powers. In Virginia, where this photograph was taken, instances are numerous of animosities between different branches of the animal family being buried for a time in order that much-needed protection might be given to helpless young.

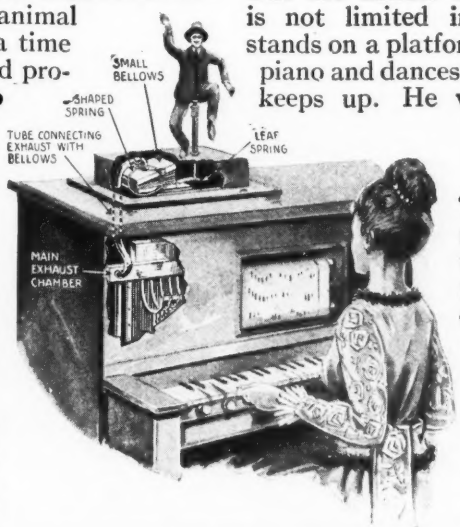
Perhaps the most unusual instance, though, of loaned maternal affection and nurture is that of a snake which came regularly to a certain pasture where a friendly cow looked eagerly for it and willingly gave of her milk, completely mystifying the farmer who was on the look-out for the milk thief. When the snake was found and killed the cow seemed to grieve as though for her calf.

The Russian Cow Protects Her Eyes with Spectacles

THE latest news from the animal kingdom is that ten thousand cows on the Steppes of Russia have been provided with dark glasses to protect their eyes from the glare of the sun on the snow. The only food obtainable in winter is a meager supply of grass which crops above the snow in places where the ground is less deeply covered. The sun shining on the snow is sufficiently dazzling to cause snow-blindness and great suffering among the animals. An enterprising and sympathetic man designed smoked glasses which could be worn with comfort and safety. These are very similar in design to those worn by the mules in mines where sulphurous gases abound. The cows, however, have a curious grandmotherly appearance in their spectacles.

Try This on Your Piano. It's a New Idea, But Not in Music

THE mechanical dancing comedian is familiar to everyone. You wind him up and he does his little best to amuse you by jigging around for a specified time. But the dancer in the illustration below is not limited in any such way. He stands on a platform on top of the player-piano and dances just as long as the music keeps up. He will dance anything for which you have a perforated record, keeping excellent time and step. The secret of the perfect rhythm which he keeps with the music is his connection with the bellows of the piano. The rod which supports him is attached to a spring which is in turn fastened to one arm of the bellows. When the piano is "pumped" the bellows move up and down. This causes the comedian to dance in time with the music.



The comedian will dance to any perforated record you play whether it be a waltz, a minuet or a fox-trot

Why Does the Heart Stop Beating at Death?

THE question, "Why does a man or an animal die?" has been answered, "Because the heart stops beating." But any hunter or fisherman who has dressed his own catch can testify to the fact that the heart does not stop beating at the moment of the animal's death. Often it will continue to pulsate rythmically for several minutes after it has been removed from the carcass. The most recent answer to the "Why?" of this is that the heart muscles themselves possess the inherent quality of contraction and will contract, or beat, just as soon as or as long as the conditions of environment are right. That is their business and they can no more refrain from doing it under the right conditions than a rose could help giving out its fragance.

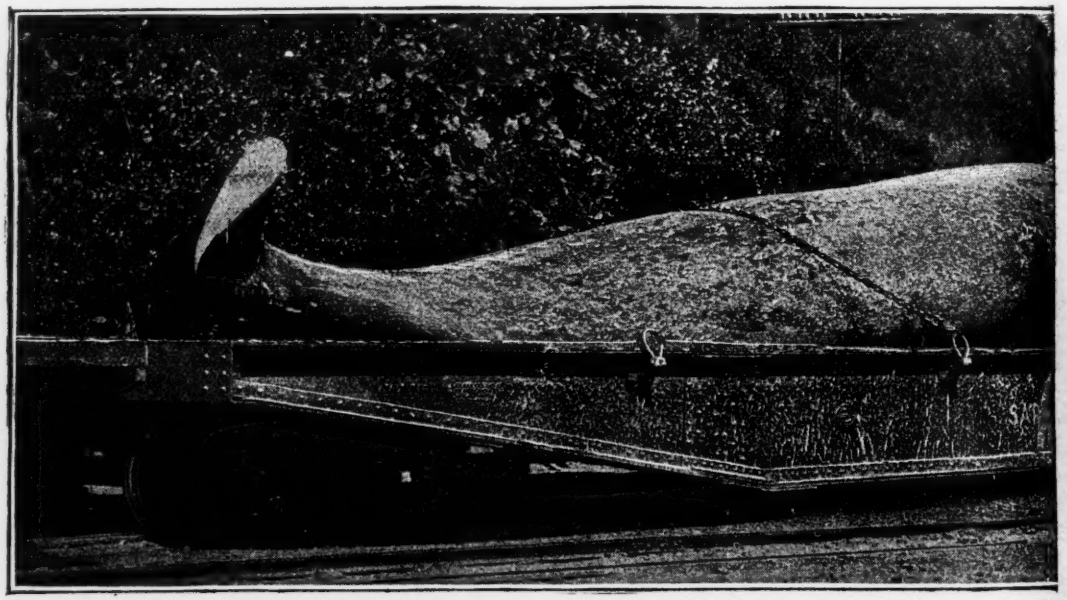
In recent experiments it has been found that heat is the principal element necessary to the development of heart muscles and their subsequent action. It is possible to grow the heart muscles of a warm-blooded animal in an incubator. During this growth a single muscle cell has been observed to develop and wander away from the mother cell and begin to beat of its own accord. Again, several individual cells may attach themselves to each other in a colony and beat rythmically together as long as the environment is favorable.

But let the temperature of the incubator be materially reduced and the action of the heart muscles becomes sluggish. Reduce the temperature still further and gradually the rythmic action ceases altogether. The cells cease to perform their natural function because their environment is no longer right. In other words, they die because they are cold. According to this theory, the heart muscles could live on independently of a body, if kept at the proper temperature for their best development.

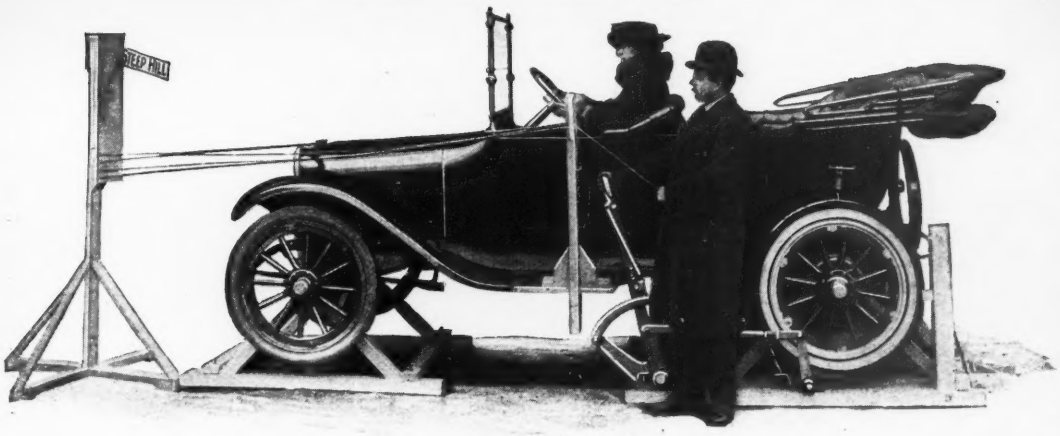
A Land Ride for Whales in South Africa

A HUGE motor-truck equipped with flanged wheels for use on a standard-gage railroad has come to the rescue of a whaling company in South Africa and has solved its transportation problem. The whales are carried by truck from the shore and are transported to the factory to be treated for the extraction of oil and other products.

The whales are hoisted on the truck by means of derricks and when once in place on the truck body they are securely lashed by chains. The truck is sixty-five feet long. It has a capacity of one hundred and sixty thousand pounds. The six-wheeled supports for the truck body keep the axle loads down to the required limits and insure the necessary flexibility over the railroad line.



Transporting whales in South Africa by means of a special motor-truck railroad car. Whales weighing as much as eighty tons can be transported in this manner from the shore to the



The anchored car is raised from the ground, heavy castings take the place of the rubber tires on the rear wheel to give momentum to the gear-shift, and a special mechanism gives warnings

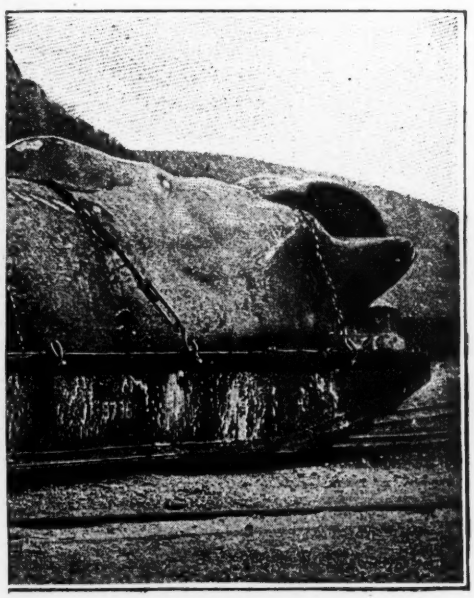
Learning to Drive an Automobile in a Stationary Car

LEARNING to drive an automobile on a crowded city street is a rather nerve-racking experience. A better way is to sit in an anchored car like the one illustrated above, which is an invention of Mr. C. M. Bishop, and imbibe instructions. The first lesson is devoted to familiarizing yourself with the controlling devices of the car, and on this imaginary trip, you are "accompanied" by the instructor.

After that you must go it alone, while the instructor stands on the left side of the car and operates a special mechanism by which he can throw up various precaution signals and produce an effect on the engine such as would be occasioned under certain conditions on the road. The signal post, which is placed near the left front wheel is similar in plan to those used in traffic police regulations, except that they indicate "danger," "steep hill," "downhill," "road closed" and more difficult warnings as the pupil advances in the work.

The instructor, standing beside the car but out of view of the amateur motorist, operates these signals at wheel by means of strings supported by a secondary post. At the same time, he keeps his hand on the principal part of the mechanism, which consists of a lever controlling a strong band-brake attached to the rear wheels. The car is raised clear of the ground so that it cannot move. The rubber tires have been removed from the rear wheels and heavy castings put in their place. This weight gives the same momentum to the gear-shift as would be obtained on the road, while the band-brakes controlled by the instructor operate against the entire surface of the iron tires.

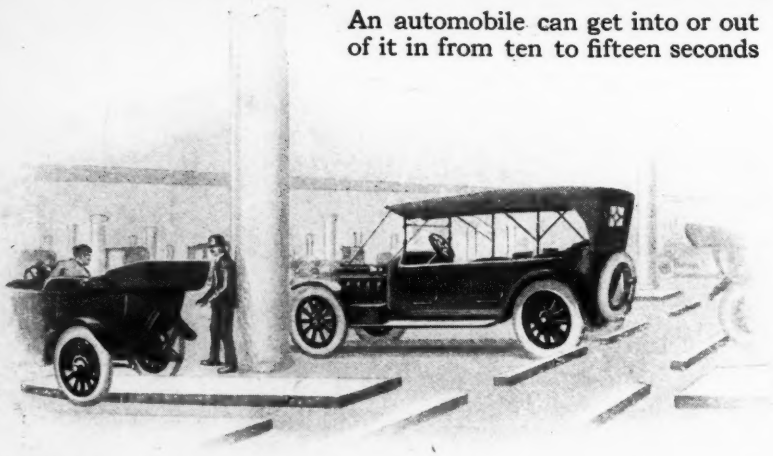
The instructor can stall the motor in any speed, and the pupil learns by actual experience what to do in every contingency. It seems reasonable to suppose that the student will absorb the instructions more quickly on account of the elimination of the things that cause nervousness. There are no pedestrians to get under the wheels; no plate-glass windows to loom suddenly up in close proximity; no hills to slide down at breakneck speed and no relentless blue-coat on guard with stop-watch in hand, should the speeds get mixed.



factory to be treated for the extraction of oil and other marketable whale products

A Model Six Hundred-Car Garage

An automobile can get into or out of it in from ten to fifteen seconds

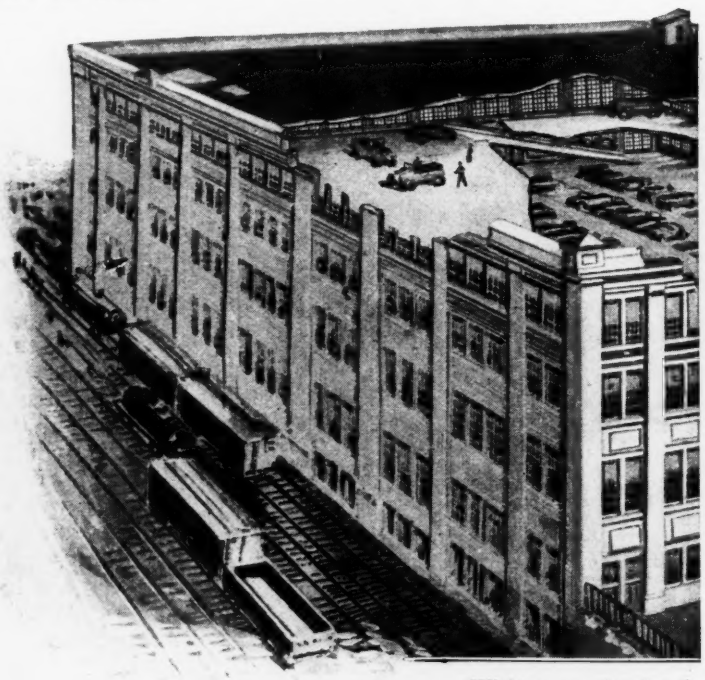


Each car has its own stall in the form of an island platform which guides it into or out of the aisle. This eliminates crowding and exasperating delays

IN the giant garage shown on these two pages, the exasperating delays often encountered in getting cars into or out of the aisle are eliminated, because the garage has no elevators and the cars are automatically spaced on the floors in such a manner that there is sufficient room for each one to run out into the aisle without disturbing the cars next to it.

Inclined concrete ramps take the place of elevators, each ramp being twenty feet wide. They are arranged so that one line of cars goes up while another line is coming down. There is a concrete curb in the center of each ramp, to restrict the lines of cars to separate paths, so as to prevent collisions between cars passing in opposite directions. Besides being a great convenience to the individual automobile owner, these two-way ramps will effect a saving of approximately $18,250 in annual overhead expense for the garage-owner. The ramps from floor to floor of the four-story structure take up the same amount of room as elevators, but the cost of building them is the only expense connected with them. It costs nothing to operate them when once built. The designer of the garage, H. B. Mulliken, of New York city, has calculated that the cost of each trip of an elevator is ten cents and that the average daily number of cars going up and down in the six hundred-car structure would be two hundred and fifty, making five hundred trips in all.

The delays incident to backing a car into its stall between two other cars whose positions are only approximated by whitewash lines on the floor or numbers on the walls, have been eliminated by the use of island location platforms much the same



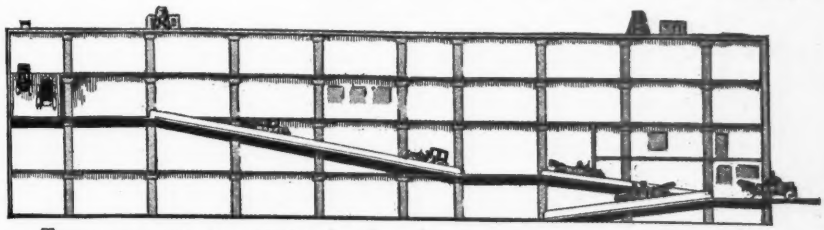
With a capacity for six hundred cars the new

as the isles of safety for pedestrians in our most-congested city thoroughfares.

These island platforms are a special feature. Each car has its own island platform, which is made of concrete, integral with the floor. Each platform is ten feet long, forty-nine inches wide and four and one-half inches high, with a rounded, but slightly pointed end facing the aisle. The cars are arranged in two long rows with an open runway between for entrance and exit.

As each car enters the aisle it is backed up until its rear wheels strike the curved end of the platform. This serves to guide the vehicle automatically into its stall, with the platform situated longitudinally beneath the car, and its edges almost touching the insides of the front and rear tires. As the platform is of sufficient height to prevent the car from mounting it when backing up, each vehicle is automatically placed in its proper position, and will be prevented from running in any other.

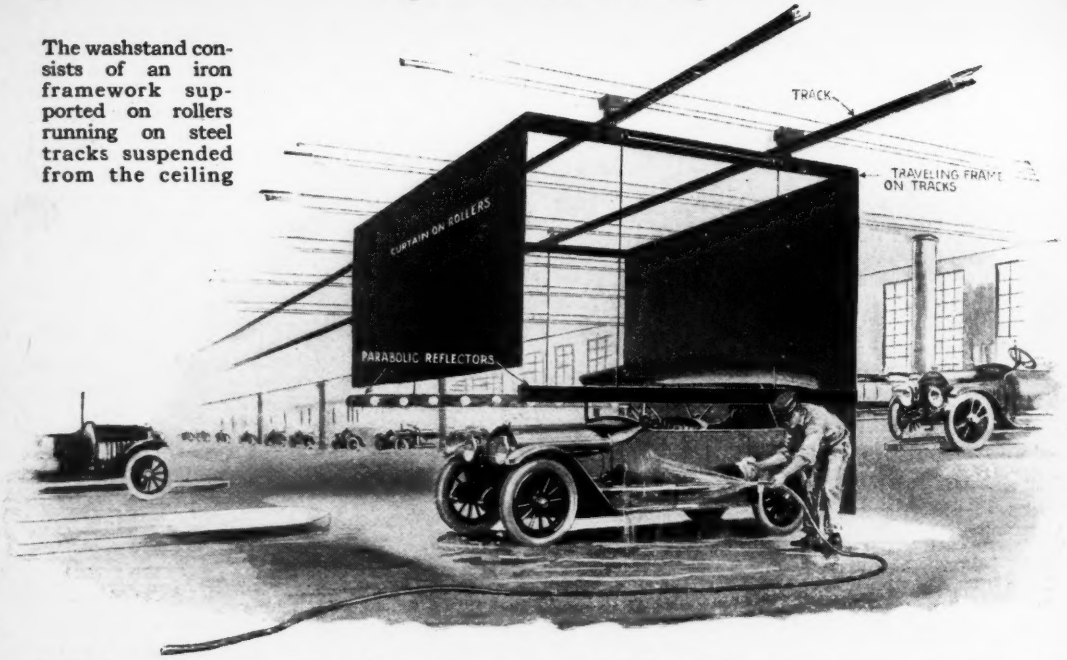
The island platforms are arranged in long rows, as shown in the accompanying illustration, and are placed so that there are fourteen inches of clear space adjacent to the vehicles. This is sufficient to allow each car to back into or run out of its stall without disturbing the cars next it. The platforms, being inside of the car wheels, do not prevent jacks being used in the clear space between vehicles to lift the wheels off the floor for the removal of tires. A small concrete bumper, about two feet long, six inches wide and six inches high, is provided behind each of the clear spaces between the islands at the rear, to serve as stops for the rear wheels of the cars.



Two-way concrete ramps take the place of elevators. The ramps are twenty feet wide, permitting one line of cars to go up and another to go down at the same time without danger of collision or other mishap

This garage, which is being built by one of the large automobile concerns in New York city, is four stories in height, with a total floor area of 205,000 square feet; of which 164,000 square feet will be given over to the accommodation

garage will be the largest structure of its kind in the world. The garage will have a restaurant and clubroom for chauffeurs and will offer every personal convenience to owners



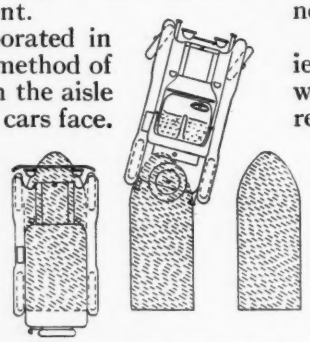
The washstand consists of an iron framework supported on rollers running on steel tracks suspended from the ceiling

of six hundred cars. As shown in the accompanying cross-sectional view, one of the ramps leads from the street level into the lower or basement floor, while another leads from the second to the third floor. Still another ramp, at right angles to the second, serves the fourth or top floor. The maximum grade is fifteen percent.

Another original idea incorporated in the design of this garage is the method of washing the cars. This is done in the aisle toward which each two rows of cars face. A movable washstand is provided, which overcomes many of the difficulties and some of the expense connected with washing the vehicles.

This washstand consists of an iron framework supported on rollers running on steel tracks suspended from the ceiling and extending the entire length of each aisle. Canvas curtains mounted on spring rollers like ordinary window shades are hung from the frame on the sides parallel with the length of the aisle. These protect nearby cars from the splashing. On the other two ends of the frame are hung two banks of electric lights in parabolic reflectors, which are also supported on spring rollers.

In operation, the car to be washed is pushed straight out into the aisle. The washstand framework is then pulled up into position by means of a rope, the curtains and lights being close up to the frame so that they clear the top of the car. The curtains are then pulled down to protect the fronts of the cars facing the aisle, the lights are adjusted to illuminate the proper parts, and the vehicle is then washed with hose attached to convenient water taps near the structure columns.



Backing a car into its stall. The island platform guides the car into place

Among the special conveniences provided are a large room where owners can make minor repairs on their cars; lockers for each car owner; a restaurant and club-room for chauffeurs; a vacuum system with taps on each floor for cleaning car interiors and the usual gasoline, water and oil pipelines with draw-off stations at several points on each floor.

When Postage Cost Ten Dollars an Ounce

SAN FRANCISCO has had an interesting history. The first settlement dates from 1776. The United States flag was raised over the town in 1846. Two years later the city had an estimated population of twenty thousand, caused by the inrush of fortune seekers. The first regular overland mail communication with the East was established by pony express in 1860, the charge for postage being five dollars for half an ounce.

Safeguarding the Eyes of Horses with Goggles

SULPHUROUS fumes rising from heated crude oil made life miserable for the horses and men employed in a Los Angeles briquette plant. Clouds of yellow smoke, surcharged with the fumes, hung over the yards. Its effect upon the eyes was extremely painful and injurious.

To protect the horses as well as the men in carrying the steaming material to the briquetting machine, both were fitted with goggles. The drivers were equipped with a type similar to that used by motorists, while the horses wore an apparatus composed of circular pieces of mica set in metal rims and held in place by a leather mask.

A horse wearing goggles to prevent sulphurous fumes and smoke from injuring the eyes

"Busting the Bronchos" of the Sea at Palm Beach

THE Old Man of the Sea and all his mermaids are wondering what the commotion in the vicinity of Palm Beach can be. Riding the surf each balmy morning appear men and women mounted upon what appear to be real sea serpents but which, upon closer examination turn out to be steeds made of wood and canvas. Breasting the waves astride these floating creatures is society's latest diversion.

The sensation is not so thrilling as surf-riding on boards, as the Hawaiian does it. That is due in part to the fact that these sea bronchos can be ridden with very little practice. The photograph gives an idea of the amount of enjoyment the sport affords. The man directing his mount is one of the most expert surf-riders.

They ride the surf at Palm Beach now on curious rolling, pitching horses made of wood and canvas

Why There Is Nothing "Just As Good" as Cork

WHEN a man goes into a hardware store for a supply of cork for some specific purpose, he generally gets what he asks for. The reason why the dealer does not endeavor to persuade him to try something else "just as good," is because there is nothing else he could offer. Cork is cheap, and for ages it has stood alone in its field of usefulness. It is tough and elastic and its specific gravity is only 0.24. This added to the fact that it is impervious to water, accounts for its use in life-preservers.

The cork oak which grows principally in Spain, Portugal, Algeria and Southern France, furnishes the supply. Only the outer bark of the tree is used for the commercial product. When the tree has attained a diameter of approximately five inches, which it usually does by the time it is twenty years old, the cork, as the first stripping of bark is called, is removed. This cork is so rough, coarse and dense that it has little commercial value. But its removal does not kill the tree. On the contrary, it seems to promote development. The stripping is done in July and August, and great skill is necessary in order not to injure the tree. If it is injured at any place the growth there ceases and the spot remains ever afterward scarred and uncovered.

But if the stripping is correctly done the growth of new bark begins at once and the subsequent layer is of finer quality than the one removed. Each year the inner bark—the real skin of the tree—forms two layers of cells, one within, increasing the diameter of the trunk, and the other without, adding thickness to the sheathing.

The instruments used in the stripping are either the crescent-shaped saws of the Algerians or the long-handled, wedge-shaped hatchets of the Spaniards. A mark is cut clear through the bark around the base of the tree and another just below the main branches. The two parallel incisions are then connected by longitudinal slits, following the deepest cracks in the bark, after which the bark is pried off.

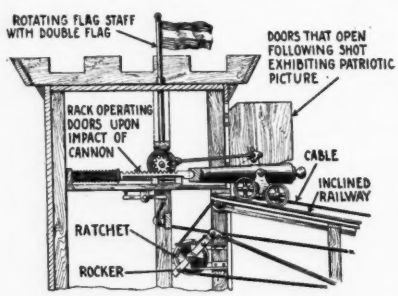
The Stars and Stripes Forever!

A new strength-testing amusement device which settles an international question

The player first deposits a coin in the slot and turns the crank in the box at the base of the apparatus. This unlocks the cannon from its moorings so that the player can shove it up the incline

THE player who undertakes to settle the patriotic question involved in the timely exercising game devised by Hans Gafner, Escanaba, Michigan, must be well prepared. His delivery must be strong or his "cannon" will go up the incline and down again, while the Foreign flag still flies above the fort. The object of the game is to displace the Foreign flag on the fort and to raise the Stars and Stripes by the impact of the missile driven by the player.

The player first deposits a coin in the slot and turns the crank in the box at the base of the apparatus. This unlocks the cannon from its moorings and permits the player to move it into the field for action. Following this the player grasps the railing firmly with one hand, and seizes the cannon with the other. Then he gives it a hard, firm push to send it up the incline, where on reaching the top of the incline it registers spectacularly. The Foreign flag is supplanted by Old Glory, and the doors of the fort swing outward, displaying a gay and patriotic picture. The result is obtained by means of a spring-pressed rack within the fort or tower, with which the cannon makes impact, and by means of which the flagstaff bearing the United States flag is rotated into display position and the Foreign flag rotated out of view. Bevel gears connect the flag staff with a rod that is rotated by another gear that meshes with the toothed portion of the spring-pressed rack. The friction of the prominent cable retards the cannon as it rolls down the incline, so that its return is not a rapid one. When it finally rolls back to its starting point it hits a lever that again locks the cannon and causes the doors of the fort to close and the flags to return again to their original position.



Detail of the end of the incline and the interior of the cabinet

The operation of the device is unique, but the principle involved is the same as that of the "test-your-strength" apparatus familiar to frequenters of Coney Island and similar pleasure resorts. In the older device a hammer is used to strike a great ball, which rings a bell at the top of the column.

Zinc Wire Is Now Used at the German Front

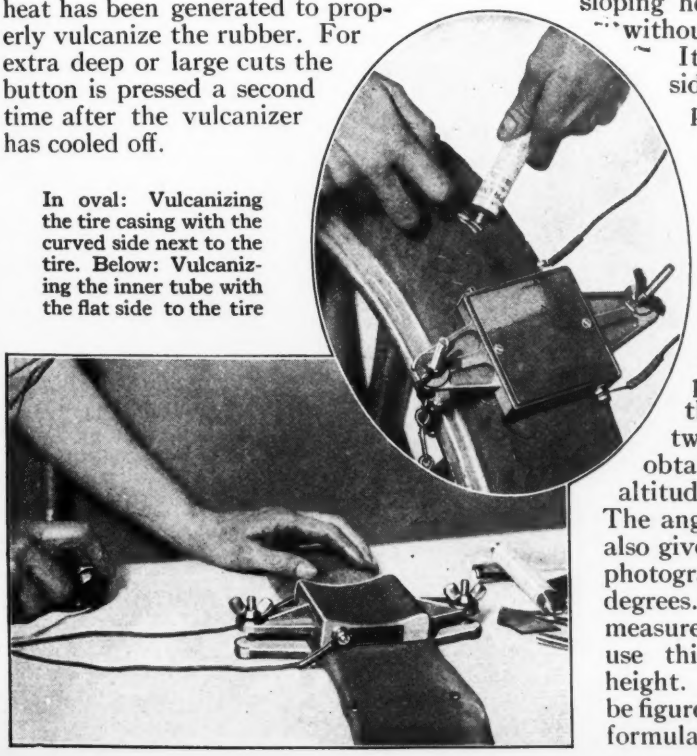
IN order to save as much as possible of her copper and iron, Germany has developed the zinc wire. She is now using it for both ordinary electric wiring at home and for telephone work at the front. Considerable trouble was experienced, however, in perfecting the various stages of manufacture. The process of drawing the wire was especially difficult. But after innumerable experiments success was attained. The new wire has been found to have double the conductivity of iron wire.

Doing Your Tire Repairing at Home with an Electric Vulcanizer

AN electric vulcanizing outfit which enables the automobile owner to make his own casing and inner-tube repairs in twenty minutes or less, has been placed on the market by a western manufacturer. It consists of a vulcanizer with a curved surface for casing and a flat surface for inner tube repairs. Repair materials provided consist of Para rubber, cement, wax paper and emery cloth. The vulcanizer works on a one hundred and ten-volt electric circuit.

In repairing a cut in the casing, gasoline and the emery cloth are used to clean the damaged part. With the cut spread open, two heavy coats of cement are applied and are allowed to dry. After this the hole is filled level with small pieces of rubber gum and the repair covered with wax paper. Then the vulcanizer is ready to be attached. This is done by applying the curved portion against the repair and fastening it securely to the casing by placing a chain around the felloe of the wheel and drawing up the thumb-nuts.

After connecting the vulcanizer to the current supply, the button is pressed and the repair proceeds automatically, the electric circuit being opened when sufficient heat has been generated to properly vulcanize the rubber. For extra deep or large cuts the button is pressed a second time after the vulcanizer has cooled off.



In oval: Vulcanizing the tire casing with the curved side next to the tire. Below: Vulcanizing the inner tube with the flat side to the tire

Determining the height of a spire by multiplying the reading of the instrument by one-half of the length of the spire's base

Measuring Sloping Roofs Without Breaking Your Neck

THE instrument shown in the illustration above is designed to enable a workman to determine the vertical and sloping height of a spire quickly and without risk.

It is placed against the sloping sides of a roof, the pivoted pointer is made level, and a basic number by which to calculate the height of the roof is immediately obtained. For example, the number given by the instrument when fitted against the side of the triangle shown in the photograph is twenty. By multiplying the number of feet in the base of the triangle by twenty we will immediately obtain the vertical height, or the altitude, of the triangle in inches. The angle at which the side slopes is also given, and for the triangle in the photograph, this is roughly sixty degrees. Hence it is necessary only to measure the base of a church spire and use this instrument to obtain its height. The sloping height may then be figured from the simple well-known formula for right triangles.

The town house in which the twenty-five prize dogs find their canine heaven is lavishly furnished. Their meals are served by Japanese waiters, and they sleep in dainty steel cribs luxuriously padded

These Canine Aristocrats Have Town and Country Mansions

DOZENS of socialists are born every time the newspapers print an account of some prodigal millionaire who gives diamond jewelry as favors at a banquet. But the sumptuous mansion for lap-dogs, two rooms of which are shown in the photographs above, will create more bomb-loving socialists than the most ambitious of banquets was ever responsible for.

New York has another thing to be ashamed of. If every man who is conducting a personal "hunger strike," walking jobless about America's streets, possessed a good position and plenty of food, one might contemplate the "finest dog house in the world" with a degree of good-natured forbearance.

Scented baths in individual basins of finest crockery are provided for the twenty-five little aristocrats

Twenty-five prize dogs, with plenty of choice food and warm beds, have an ideal existence at their "town house," in the heart of New York city. To make matters even more unbearable to the socialist, a summer house is provided for them in the country.

The "town house" is lavishly furnished with Japanese furniture and ornaments. Each dog has a valet or maid.

An Ant Can Carry Ten Times Its Own Weight; But Suppose It Were Bigger

"GO to the ant, thou sluggard," and watch it carry a weight fully ten times its own, for a distance equivalent to miles considering its size, and then blush for shame because man cannot do at least as much. Let the horse blush, too, for even it can carry loads only about equal to its bodily weight.

But is the ant really so superior in strength? Would it be able to perform its remarkable carrying stunt if it were as heavy as a man or a horse? Science says not, and explains that since an ant's strength is in proportion to its cross-section, not to its length, if it should grow to twice its original size retaining its natural geometrical structure, it would be only four times as strong, although it would be eight times as heavy. Thus its strength would be relatively halved rather than doubled. Following the same line of reasoning, if the same ant should grow to be the size of a man, it would be able to carry only one one-hundredth of its weight, which is less than a human baby can do. Therefore, exit the ant as a perpetual reproach to man's puniness.

A Folding Walking-Stick with an Electric Flashlight

THE walking-stick is a favorite object of experiment with the inventors—or it seems so. Efforts are constantly being made to lift it into the ranks of the really useful. The one equipped with the little electric lamp is no longer a cane oddity. It made its debut fully three years ago. But the same cane in the new folding shape is certainly the first of its kind to come our way. The light switches on and off just as the light in the old cane did. You simply twist the metal covering over the light socket and the bulb comes to life. But the new cane has a decided advantage over its predecessor. You can pack it in your trunk and traveling bag and take it along wherever you go.

The two parts of the cane are connected by a steel rod with two pivoted elbows. Thus the cane can be taken apart and the upper and lower sections placed parallel with each other.

The lamp is located at the most convenient part of the stick—just a hand's length from the curved handle of the cane. Here it is not in any danger of being turned on accidentally as it would be if it were further up or down, and it is in just the proper position to throw light on the keyhole or on other near or distant objects.

The folding cane which is equipped with an electric flashlight in a most convenient location

Thirty-nine lengths of pipe were coupled together to make a compressed air container of about fifty cubic feet capacity

Improvising a Compressed Air Tank from Pipes

IT is particularly difficult with the present shortage of freight cars to obtain equipment of any kind. Long delays are the rule before even standard apparatus can be delivered. But sometimes, in a pinch of this kind, mechanical ingenuity comes to the front and solves the problem without delay. For instance, a contractor needed a compressed air-storage reservoir quickly. An eight-inch well, two hundred and twenty feet deep had been cased all the way down and screened. Quicksand then entered. To remove it, compressed air had to be employed. No suitable air-tank was available, and no manufacturer would promise delivery for weeks. So the contractor hooked up lengths of ordinary pipe, as shown in the illustration.

Thirty-nine lengths of pipe were used, each six feet long and six inches in diameter. Their combined storage capacity amounted to about fifty cubic feet. The makeshift served its purpose admirably. There was very little delay and the pipe was usable for other purposes when it was no longer needed to supply compressed air.

Trapping Muskrats

A new industry for the ambitious boy

By Charles Curtis

Removing the skins from the stretching boards where they have been for two weeks

THREE youngsters are making enough by trapping muskrats in the Hackensack marshes of Jersey to equip themselves with bicycles, baseballs, bats, gloves, and all the other things that a boy yearns for. They are Charles Curtis, aged 11, Harold Freet, aged 15, and George Halk, aged 16. All are of Hackensack, N. J., and all attend school. Harold Freet is the chief trapper, and the one from whom the other two obtained their instructions. During Freet's spare time he hob-nobbed with the bridge-tender on the Court Street Bridge, over the Hackensack River. This bridge-tender was a trapper himself and knew the habits of muskrats, the laws governing their trapping, and the market value of the pelts. He imparted all his information to Freet, and Freet in turn told his two pals. When the season opened, the three of them went at it with a will.

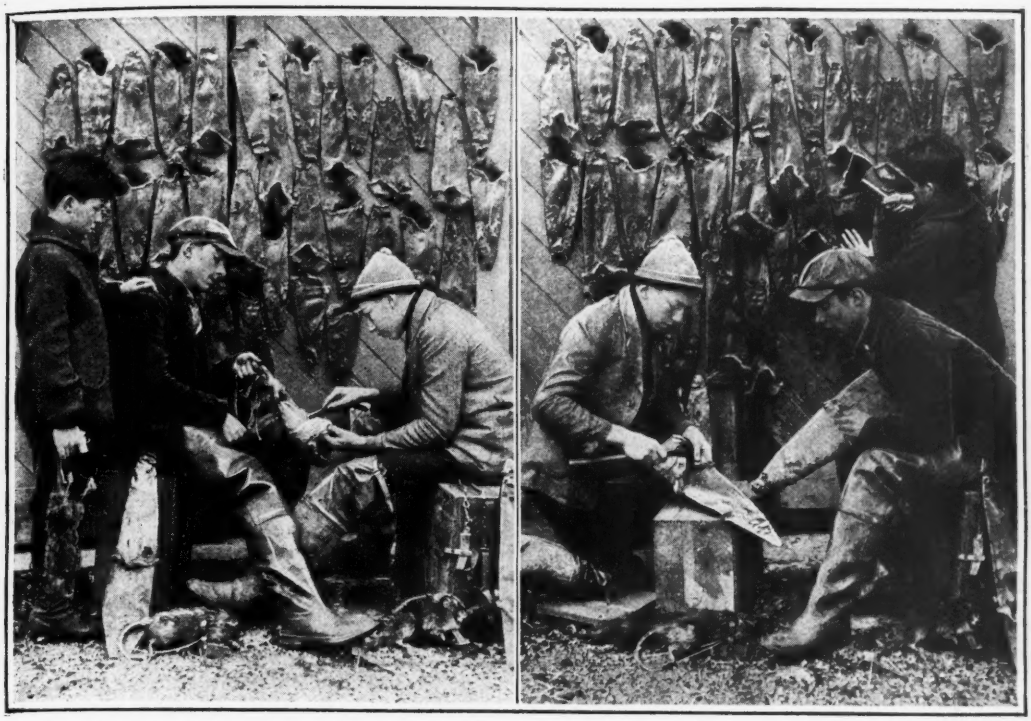
The trap catches the rat by the leg. If the rising tide does not drown it the boys kill it humanely

Muskrats cannot be shot under the New Jersey law; nor can they be hunted at night with searchlights. They must be caught in traps, and in no other way. The youngsters therefore purchased about fourteen "jump traps" and set them out in the Hackensack Meadows. These traps cost about twenty cents each, and are the best for the purpose. When the rat springs a jump trap, he is caught firmly by the leg.

The traps are always set and emptied when the tide is out; for that is the only time they may be reached. And whether the tide is out early in the morning, or late at night, the boys have to be there. If the tide is out early in the morning, young Curtis and Halk each ties a string to his big toe when retiring the night before and drops the string out of the window. Freet delivers papers in the morning, and is therefore, always the first to be up. When he has delivered his papers he goes to the houses of his co-workers and pulls away on the string. In a very few minutes his companions are with him.

The traps are generally set near the muskrat lodges. The lodges are capacious dwelling places for the muskrats, built of grass, leaves, and rushes, about three or four feet in height and they are always situated so that they will be above tide water. The traps are placed in the runs that lead in and out of the entrances. The law governing such trapping, however, states that the traps must not be set closer than two feet to the entrance. This gives the rat a chance for his life. If this law is violated by a trapper, he may be fined twenty dollars.

When the traps are cleared, the muskrat



The picture at the left shows the boys skinning a muskrat. The skin must be removed whole, without cutting. At the right the boys are stretching and tacking two new skins to the boards

is generally alive. Often, though, the rising tide has drowned him. But if he is alive, he is speedily dispatched by a blow on the head from a stick in the hands of one of the young trappers. This blow must be delivered in a certain spot, so as to kill the rat quickly, and without soiling or in any way injuring the fur.

When the day's bag has been collected, it is brought home and skinned. Skinning a muskrat requires skill. When the rats have been skinned, the pelts are drawn (inside out) over a pointed board or stretcher. They are then stored in a barn or other place that is dry and well-ventilated by a current of air. At the end of two weeks the skins are sufficiently dried. They are then laid aside. When a sufficient number of pelts have been collected, Freet brings them over to the fur market on West 13th Street, New York city, where he receives forty-five cents each for them.

The season opens on November 1st, and closes on April 1st. As the season gets older, the skins become more valuable, until, toward the end of the season, they are worth seventy-five cents each.

Just prior to the Christmas holidays, these boys had collected and sold forty-eight pelts. With the money resulting from the sale of these pelts, they treated themselves to a few things they needed and bought Christmas presents. Then they returned to Hackensack to renew the campaign and to collect more skins, for which they will purchase what they want for the summer.

The Latest Kind of Artificial Feet Are Made of Paper Pulp

IN spite of the fact that there is little fiction in the stories of the soaring price of paper, the uses to which this product is being put are constantly increasing in number. We have paper furniture, paper cloth, paper silks and clothes, and even paper legs.

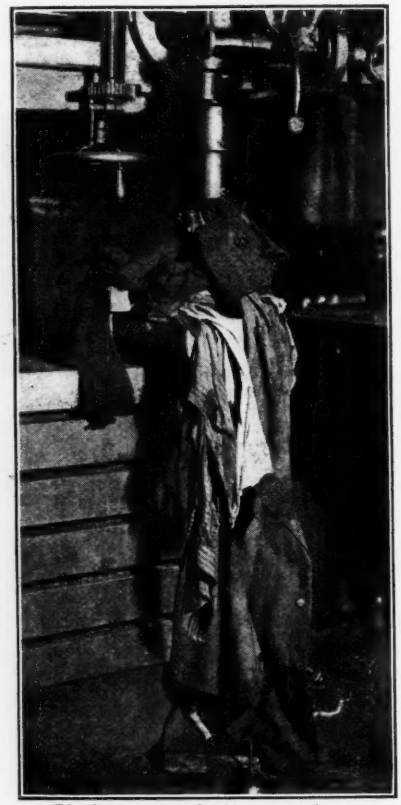
Now Dr. Svindt, of Denmark, who is responsible for the artificial leg of papier mâché, has brought forward a paper foot, intended to meet the needs of the crippled soldiers. These feet are said to be strong enough to withstand ordinary usage, and they have the added advantage of being cheap. A model of the foot is made of wire gauze, and upon this is poured a specially prepared pulp which entirely fills the interstices of the wire gauze.

Stripped of His Clothes by a Projecting Cutter

THE collection of clothing shown in the picture is interesting only as an illustration of how close a careless workman can come to a serious accident and yet get off practically unscathed. The man in question was cutting an elongated hole in a die block with a cutter projecting about three-sixteenths of an inch.

While the drill press was in motion, the elbow of the workman, who was leaning on his work, came in contact with the cutter. The cutter caught his sweater and stripped him of practically his entire clothing, consisting of sweater coat, street coat, overalls, vest, shirt and undershirt.

The beneficent Providence that watches over even the criminally careless saw to it that he escaped with only a dislocated shoulder.



Clothes torn from a workman by a projecting cutter on a drill press. He was only slightly hurt

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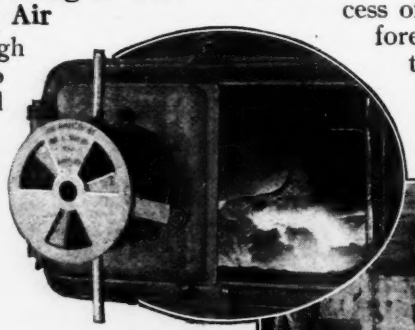
Saving Coal by Feeding a Fire with Hot Air

OUR fuel bills are high because we get so little heat from the coal we burn. If we could take out of a piece of coal all the heat that Nature has stored up in it for us, our coal bills wouldn't bother us. As it is, we waste most of the coal we burn. Half the heat goes up the chimney and most of the gases arising from a hot bed of coals will not burn because the fire isn't hot enough to make them combustible.

To eliminate this unnecessary waste Charles W. Huse, of Gary, Indiana, has invented an air-feed, or auxiliary draft, which introduces heated air into the firebox, thus giving a perfect mixture of all the gases and forcing the flames to all parts of the firebox. The air is admitted through an air-intake equipped with handles and a regulating shutter. It is taken to the firebox through a tube. A nozzle on the inner end of the tube distributes the heated air over the flames.

When the furnace is being fired the door as well as the tube is swung around to one side out of the way; or the tube can be raised, lowered, or turned in any directon. Thus, in banking a fire for the night, the nozzle of the tube is turned upward by means of the handle, allowing the heated air to pass through the flues of the boiler or furnace.

The nozzle is made of a specially prepared metal which will stand excessive heat even when the air is not passing through it. The heat supplied by the furnace after the installation of the device is greatly in excess of the amount given out before, even though only one-half the usual quantity of coal be used. The saving, therefore, is obvious.



The air-feed, or auxiliary draft, which introduces heated air

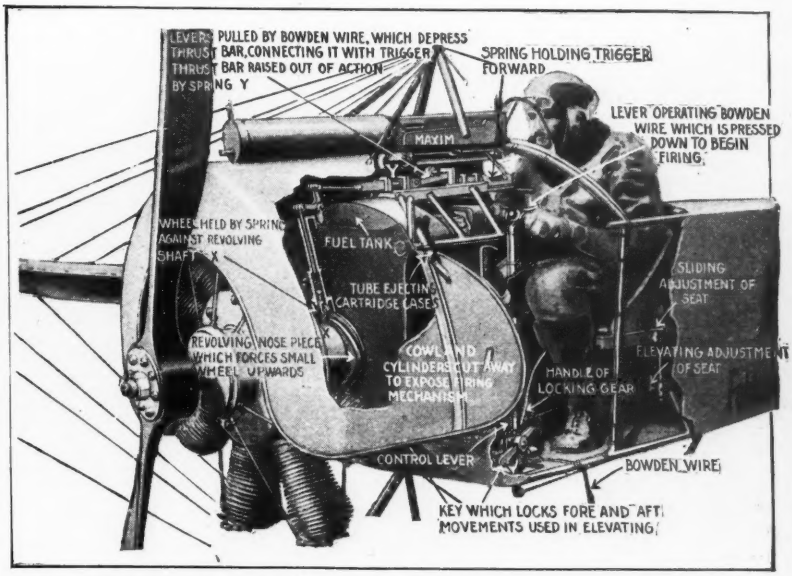
The tube as well as the door may be swung around out of the way, or it may be raised, lowered, or turned in any desired direction

The Cavalry Horse of the Air

At last the secret of German fighting aeroplanes is revealed

By Carl Dienstbach

BY this time everyone has heard of the famous Fokker aeroplanes — the fighting chariot of the air in which the famous German aviators Immelman and Boelke performed so many daring exploits! Very little has been published by the Germans about the Fokker beyond the fact that it is swift and strong, and that it can shoot up like a balloon, plunge like a stone, rise again, tumble about, and fight like a cavalry horse, all because of its excessive power and its extreme lightness.


LEVER PULLED BY BOWDEN WIRE, WHICH DEPRESS THRUST BAR, CONNECTING IT WITH TRIGGER
THRUST BAR RAISED OUT OF ACTION BY SPRING Y
SPRING HOLDING TRIGGER FORWARD
LEVER OPERATING BOWDEN WIRE WHICH IS PRESSED DOWN TO BEGIN FIRING
MAXIM
WHEEL HELD BY SPRING AGAINST REVOLVING SHAFT X
FUEL TANK
TUBE EJECTING CARTRIDGE CASES
SLIDING ADJUSTMENT OF SEAT
REVOLVING NOSE PIECE WHICH FORCES SMALL WHEEL UPWARDS
COWL AND CYLINDERS CUT AWAY TO EXPOSE FIRING MECHANISM
HANDLE OF LOCKING GEAR
ELEVATING ADJUSTMENT OF SEAT
CONTROL LEVER
BOWDEN WIRE
KEY WHICH LOCKS FORE AND AFT MOVEMENTS USED IN ELEVATING

A cut-away drawing showing the construction of the Fokker aeroplane with its machine gun which is aimed by swinging the entire craft

Much more is now known of the Fokker. Interesting as its construction is, still more interesting is its single machine gun and the manner in which it is fired. August Euler patented the idea of aiming a gun not by swinging the weapon itself, but by manipulating the air craft on which it was mounted. That was the underlying idea carried out in the machine-gun mounting of the Fokker. Euler exhibited his device in 1912 at the Berlin Aeroplane Exposition. Prince Henry of Prussia no sooner saw it there than he ordered it to be withdrawn at once and guarded as a military secret.

Military experts have always wondered what is the best way of making an attack in the air. Ramming is obviously impossible. Bomb dropping is uncertain at high speed even at close range. Euler's invention solved the problem for the Germans. Mount a machine gun on an aeroplane so that the entire craft must be turned in order to aim the gun and a kind of ramming principle is at once applied without endangering either the machine or the rammer. The firing ranges, to be sure, are short—at most a hundred yards.

Since in racing monoplanes of the Fokker type the propeller is mounted in front, the technical difficulty of firing the gun through the blades of the swiftly revolving propeller had to be overcome. An aeroplane motor explodes thousands of charges of mixed air and gas in a minute; a machine gun fires about six hundred shots a minute. If it is possible to time thousands of motor explosions with mathematical nicety, surely it is not an impossibility to time rapid but less frequent machine gun discharges with equal ease. The propeller blades intercept the gun only during the one-fortieth part of the time required for a complete revolution. The solution was simple: Let the motor operate the machine gun and fire it at the proper time. And so that was done.

The operation of the gun by the marksman is not in the least interfered with. The pulling of the trigger indicates merely when firing should begin and end. It must not be forgotten that the propeller of the machine is directly coupled to the motor, as our illustration shows, and that it makes more revolutions a minute than the most rapid automatic gun would make firing shots in the same length of time.

Can You Name These Cars?

Here's a Chance to Win $50 in Cash

Study the photographs on pages 398 and 399. They represent parts of well-known cars. But what cars? You may recognize a car as it whizzes past, just from its general appearance. But do you know the finer points of standard automobiles? Do you know the mechanical advantages of the construction shown?

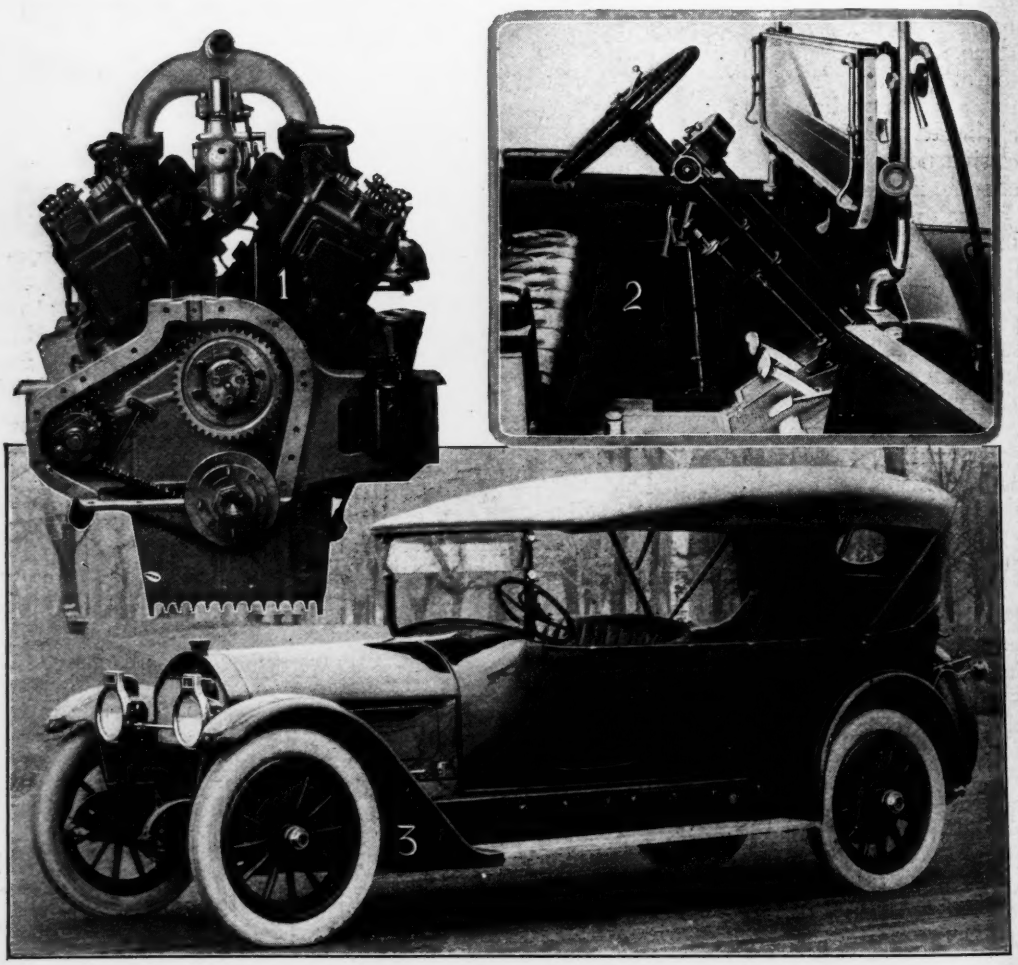
To win the $50, you must observe the following rules:

1. Use the numbers on the photographs in your answers, for identification.
2. Point out the identifying feature of each photograph on pages 398–399. State the advantages of that particular feature—whether it is commendable for mere looks, for the saving of material, for mechanical reasons, etc. This is not a guessing contest but a test of intelligence.
3. Write your answers on separate sheets of paper, each bearing your name and address. Don't make your answers part of a letter.
4. Give the reasons for each answer in a little article. Allow no more than one hundred words for each article. The prize will be awarded to the competitor who submits the best set of articles displaying the most automobile intelligence in his answers.
5. **The contest closes on March 15, 1917.**
6. The correct answer and name of the winner will be published in the April issue of the POPULAR SCIENCE MONTHLY.
7. Address answers to the

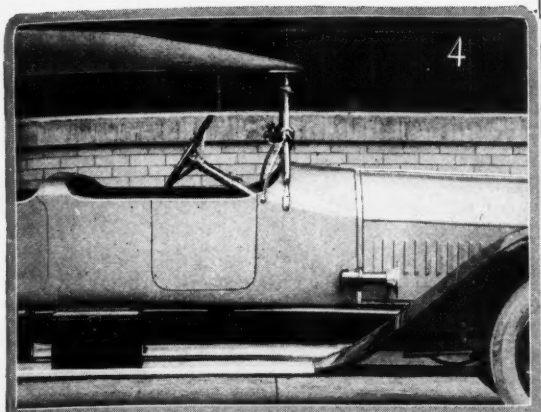
AUTOMOBILE CONTEST EDITOR

POPULAR SCIENCE MONTHLY

239 Fourth Avenue **New York**



$50 Prize Contest. See Opposite Page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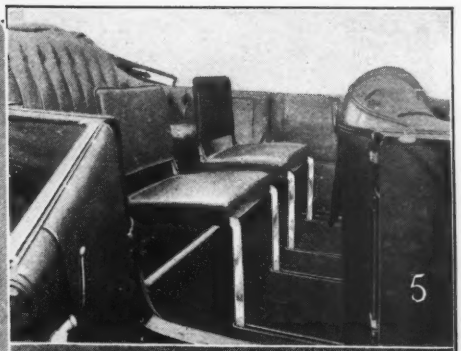
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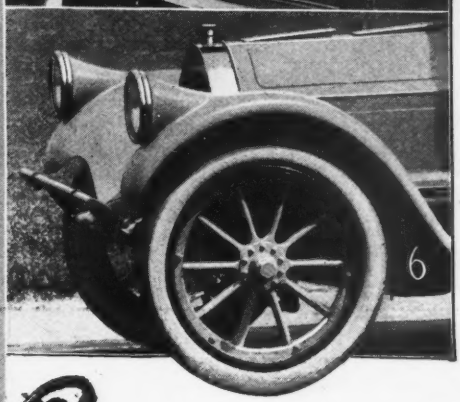
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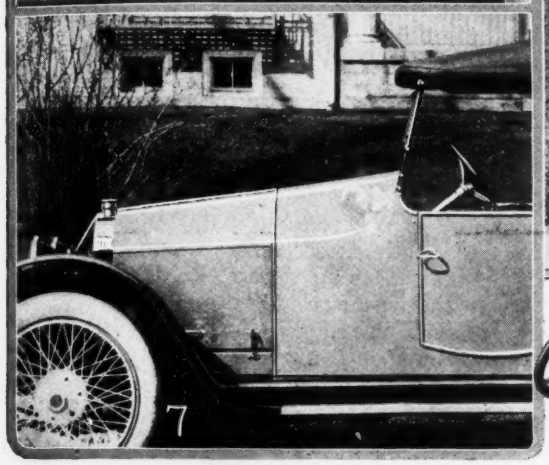
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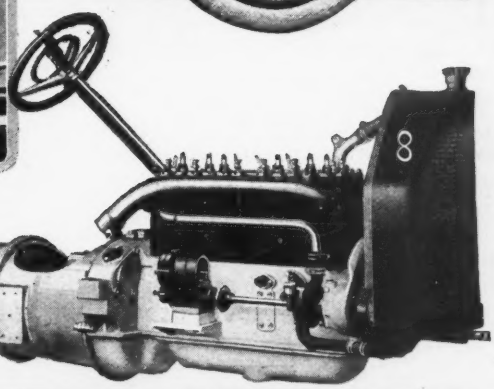
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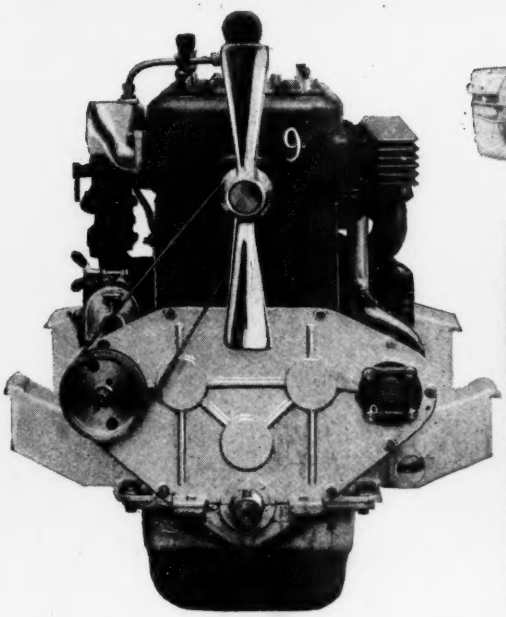
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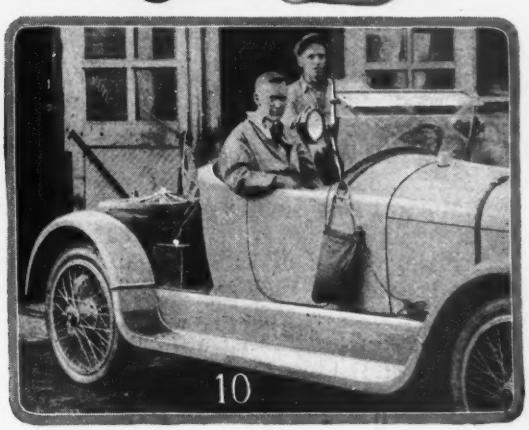
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The Latest for Hair Dressers Is a Combined Chair and Basin

A chair which has been designed to make shampooing operations easy for the shampooer and the shampooee

THE discomfort and inconvenience of getting the hair shampooed is almost entirely eliminated by the use of a special chair and basin. The chair, placed about six inches in front of the basin, has a hinged back which is lowered until the head rests comfortably on a rubber neck-piece forming part of the basin. With the head in position the hair can be washed thoroughly. Soap lotion is applied through a small faucet and hose at the left. A gas heater in a water compartment makes it possible to get hot water instantly at any desired temperature.

Sterilizing a Thousand Quarts of Water with a Vest-Pocket Apparatus

SOME remarkable claims are made for the efficiency of a vest-pocket water sterilizer that should free all travelers, campers and soldiers from the germs lurking in contaminated water.

The apparatus is distinctly portable. A complete equipment of large size is capable of sterilizing eight thousand quarts of water. It weighs only a few ounces. Ordinarily, however, the apparatus is used to purify a small quantity of water at a time, a cupful, for instance; but it may be used again and again with but slight readjustments.

The principle of the invention is simplicity itself. Two electrodes are brought into electrical contact with a battery comprising a number of dry cells, such as are used in pocket flashlights. Between the two electrodes is some blotting paper which has been charged with common table salt. Thus in placing the electrode in a glass or bucket of water, the sodium chloride, or table salt, is electrolytically changed into sodium hypochlorite, which constitutes one of the most powerful oxidizing or sterilizing agents known.

The effect of the oxidizing agent is to destroy the dangerous germs or bacteria and to render the water sterile and safe for drinking. The water does not lose any of its dissolved gases and is not flat or otherwise unpalatable after it has been sterilized. Furthermore, the salt used as an electrolyte does not impart to the water a salty taste, since very little of it is used. Within a short time after bubbles of gas evolved at the electrodes rise to the surface, all parts of the water have been subjected to the purifying oxidation. Moving the electrodes about in the water accelerates the action.

Charles F. Burgess, of Madison, Wisconsin, is the inventor.

Sterilizing a cupful of drinking water with the vest-pocket apparatus. It only takes a minute

Treating Maniacs with Water

How the modern physician soothes raving lunatics with nothing but hot and cold water

By John E. Lind, M.D.

Senior Assistant Physician, Gov't. Hospital for Insane, Washington, D. C.

The continuous bath for raving maniacs. In this the patient lives, eats and sleeps

THE expression "raving maniac" is met with constantly in the press and in our daily speech, but it is doubtful if many people know just what it means. Probably the most common picture conjured up by the term is a vision of a wild-eyed lunatic dashing madly through a terrified crowd, shooting and stabbing, until he is overpowered by the police and borne away to a padded cell where his shrieks are heard but faintly through the walls. While a maniac may run amuck in the streets before he is apprehended, this is not so common nowadays. Our knowledge of the real nature of insanity is becoming more exact, and we are able to detect its presence sooner as well as to treat it more intelligently and humanely.

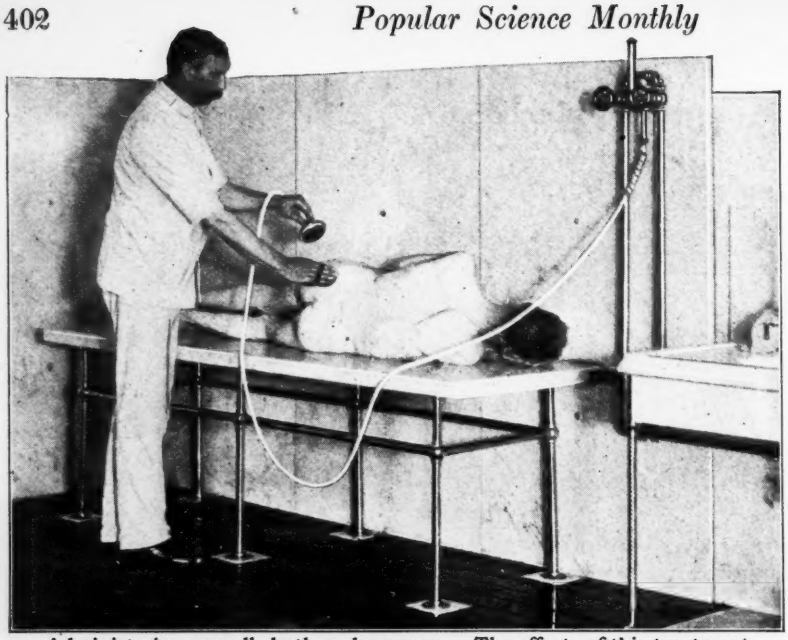
A little over a century ago the person who was mentally ill was regarded as something between a wild beast and a criminal. He was chained hand and foot to a stone wall in a dark, ill-ventilated cell; his food was doled out to him at the end of a long stick; he was exhibited in iron cages to passersby, who, by paying a few pennies, were at liberty to ridicule him or "stir him up" in any way they chose. When his keepers thought it advisable he was beaten, ducked under the water or otherwise ill-treated with the idea that the evil spirit, which was supposed to have taken possession of him, could thus be driven out. Towards the end of the 18th century, Pinel, a French doctor, made the experiment of striking the chains from the inmates of Saltpetrie, a famous old asylum at Paris. His example was soon followed throughout the civilized world. Even after this great step forward, however, many strange and, as we now see, cruel methods of treating the mentally ill were practised, such as strapping them in rotary swings which revolved a hundred times a minute, bleeding them freely, etc.

In all the history of the treatment of mental disorder it is the maniac who has given the most trouble, and naturally so. He is quiet neither night nor day. Pacing restlessly back and forth, tearing his clothes to pieces, singing and shouting, refusing to eat or sleep, he has always been a menace to life and property. In thousands of cases he has so worn himself out that, his vitality reduced to a low level, he has been the prey of some disease.

What the Strait-Jacket Means

There have been three main ways of treating maniacs, all of which have had for their basic idea the object of restraining them. The first of these ways was by actual restraint; that is, the excited person was put in a strait-jacket or bound hand and foot. What torture this was to the poor sufferer will never be known, except by those who have endured it. Some of the readers of the POPULAR SCIENCE MONTHLY have had what are termed the "fidgets," when it seems impossible to be quiet for more than a second. If you can imagine having the fidgets a hundred times as badly as you have ever had them and if you can imagine being strapped in a canvas jacket with your arms bound tightly to your sides so that you cannot move them and being kept in this way for days at a time you will have a faint idea of what the maniac suffered during the years when this was the only method of handling such cases.

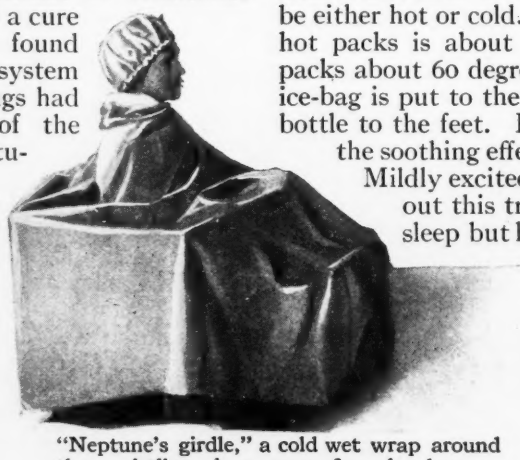
Following these mechanical devices for restraining them, patients were given power-



Administering a needle bath and massage. The effects of this treatment are soothing to the nerves and at the same time invigorating to the body

medically is to be found in the modern hospital for the insane. Besides being used for the excited cases, it is also found to have a good effect on all cases, benefiting physically even if it has little or no effect on the mental condition. Water is also found to be a valuable curative agent for great numbers of people who suffer, as the saying is, from their nerves, their trouble taking the form of hysteria or neurasthenia (nervousness) in the more severe cases and sleeplessness and periodical "sick headaches" in the milder ones.

ful narcotics, "knock-out-drops" in reality, until they sank in a stupor. When the sufferers revived a little from the depressing effects of these powerful chemicals and began to show signs of life they were again drugged. This was kept up for weeks at a time. In such a state they were of course no trouble to those who had charge of them. In the course of time they recovered; for nearly all maniacs do recover. The exponents of this method of treatment claimed to have found a cure for mania. It was found that the abuse of the system by these powerful drugs had evil results. Some of the patients passed from stupor into death, and those who recovered mentally often found their digestion ruined and their general health impaired.



"Neptune's girdle," a cold wet wrap around the waistline, is a cure for sleeplessness

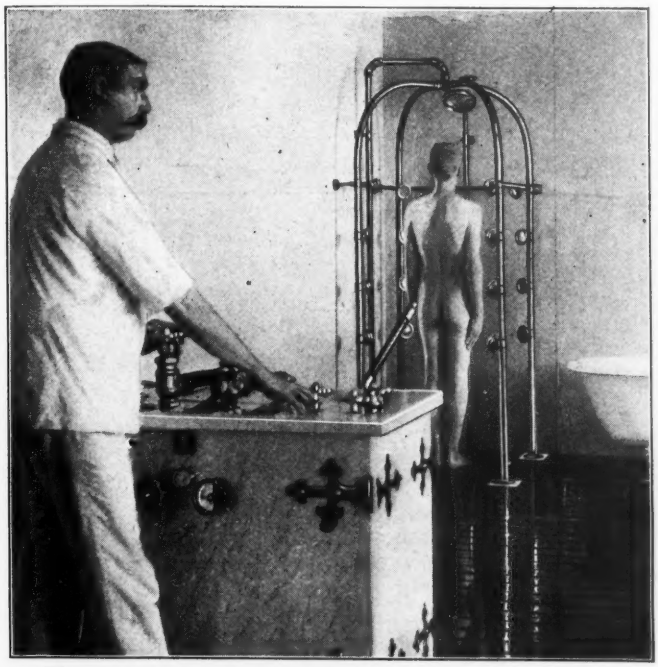
The Modern Humane Water Cure

So, the age of chemical restraint passed away and nowadays we have found a treatment so simple that it is no wonder that it was overlooked before. It is nothing more nor less than water. Hot water, cold water, shower baths, tub baths and sitz-baths, and every conceivable manner of applying water

There are three main ways of giving the water treatment—by the pack, by the "Scotch douche" and by the continuous bath. By "packing" a patient is simply meant wrapping him tightly in sheets wrung out of water of the desired temperature, pinning blankets tightly around him and leaving him in the sheets for anywhere from a half hour to two hours. Packs may be either hot or cold. The temperature for hot packs is about 105 degrees, for cold packs about 60 degrees. In either case an ice-bag is put to the head and a hot water bottle to the feet. It is astonishing to see the soothing effect on excited patients. Mildly excited patients, who, without this treatment, would eat or sleep but little, tear their clothes to pieces, use profane language, and in general cause much trouble, are kept quiet and tractable with water, and after they have been packed in at bedtime, are able to sleep soundly. A hot pack for an hour at night would cure many cases of sleeplessness in normal life, by the way.

The Scotch douche may be described as a shower bath raised to the *nth* degree of perfection. It consists of four upright

pipes forming a square; these curve over and meet at the top to form an ordinary shower. The pipes at the corner are perforated so that the patient gets the water from the sides and top at once. The Scotch douche is regulated by an operator at a table about fifteen feet away, by means of levers. A thermometer near him indicates the exact temperature of the water the patient is getting. When the patient steps in the bath, for instance, the water is made about 106 degrees, it is kept at this for about ten seconds, then the temperature is gradually reduced until it reaches 60 degrees or even lower, if the patient is able to stand cold water, the test being whether he gets a warm, healthy reaction afterwards. It is kept at this low temperature about ten seconds and then turned off. Then follows the unique feature of the Scotch douche. The operator controls at his table a short hose with a nozzle and through this he plays a stream of cold water up and down the patient's body, making it a spray against the more sensitive parts and a hard stream upon the less sensitive ones. Chiefly attention is directed to the spinal column and the cold stream is run up and down the back-bone several times. The patient then steps out of the bath and is given a brisk rub-down.

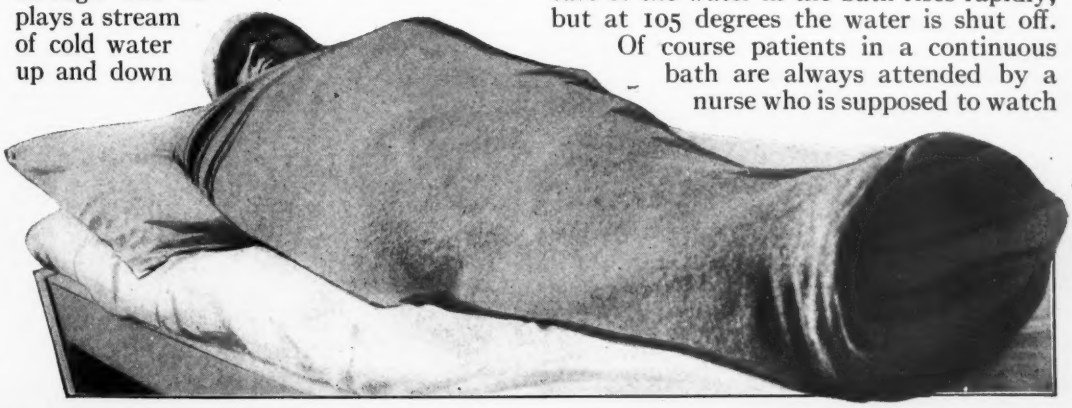


The Scotch douche is a special kind of shower bath. The temperature of the water is gradually reduced until the patient can stand a cold stream along the spine

Curing Raving Maniacs in Bath-Tubs

The continuous bath is just what its name implies and is chiefly used for very excited patients, the "raving maniacs" referred to before. An ordinary bath-tub is fitted with a mixing chamber above so that the water is kept at an even temperature, this being body temperature or a degree higher. Many of these are equipped with a safety-valve so that if any accident happens the supply is automatically shut off. Thus, if the valve is set at 105 degrees and the cold water stops running for some reason, the temperature of the water in the bath rises rapidly, but at 105 degrees the water is shut off.

Of course patients in a continuous bath are always attended by a nurse who is supposed to watch



A patient in a "pack." This consists of sheets out of which water of the desired temperature has been wrung. These are wrapped tightly about the body and over them blankets are pinned

Patients taking a hot-air bath before being given a Scotch douche. The interior of the cabinet is heated by electricity to induce free perspiration

the temperature constantly. But all human beings are fallible, and, if the nurse should happen not to be watching the thermometer during those few minutes when the water began to get hot, the patient might be scalded; hence the safety-valve.

In some hospitals a sheet is stretched across the tub over the patient, only his head projecting. In others there is nothing over the patient, in which case he can escape from the tub. He does that frequently at first; but since he has no clothes he finds the temperature of the room chilly and is glad to get into the water again. His meals are served to him in the tub. He sleeps there. He may remain in the tub for weeks at a time. The continuous bath has also been used with great success in treating severe burns.

Often before being given a Scotch douche treatment a patient is put in a hot-air bath. He sits on a stool in a little cabinet, with his head projecting through the top and a cold cloth bound around it. The interior of the cabinet is heated by electricity to 130 or 140 degrees. Soon the patient begins to perspire profusely. Then he goes under the shower bath. The same result may be obtained by a hot pack for half an hour before the douche.

Curing Sleeplessness

A simple treatment for sleeplessness often effectual involves the use of "Neptune's girdle." An old sheet is cut in half. One half is folded until it is about three inches wide. Just before bedtime this is soaked in cold water, wrung out and wrapped around the body at the waist line, next to the skin. The other half of the sheet is folded until it is about five or six inches wide. It is kept dry, and wrapped over the first sheet.

Another simple way in which water may be used medicinally is in headache. We all know what a relief a cold compress gives to a throbbing head. Sometimes a hot footbath will relieve the pain. If not, try the application of hot and cold water alternately to the back of the neck.

The description of the ways in which water is used in mental disorder must not of course be taken to mean that we have discovered a cure for insanity. We have merely found that it is easier for us and more pleasant for the excited patient to subject him to the soothing influences of the warm bath than to beat him with clubs or drug him with powerful narcotics.

Use This and Your Shoe-Laces Will Never Come Untied

MANY a disposition has been sorely strained because a simple little thing like a shoelace wouldn't behave. A Sacramento, California, man—Alexander F. Urguhart—has invented a shoelace fastener which promises to keep the laces forever in the background.

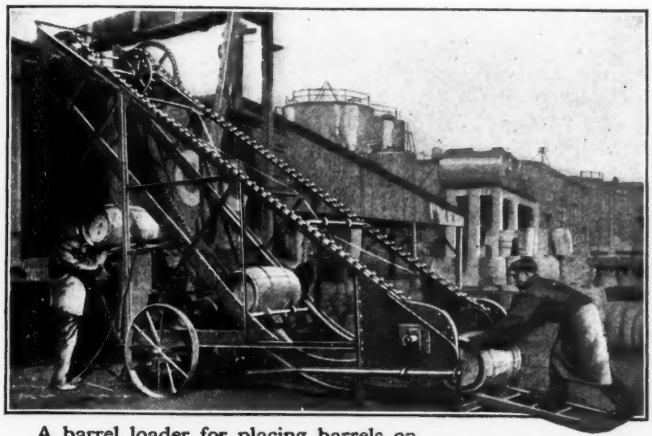
The fastener consists of a tongue and body member attached by means of punch holes and eyes

The fastener is nothing more than a single piece of stamped metal attached to the shoe half an inch from the strap at the back of the shoe. The laces are drawn up under this and held securely until removed.

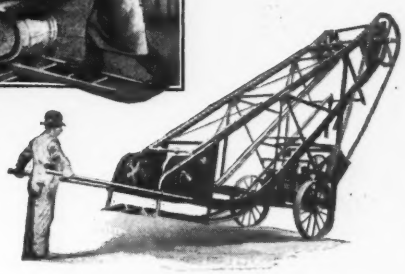
Loading Platforms That May Be Moved from Place to Place

MANY large factories and other plants are confronted by the problem of moving quickly thousands of boxes, barrels, sacks and packages from storage to wharf and from wharf to shipboard or railroad car. Using hand trucks, it would take a force of thirty men to handle one thousand, five hundred boxes an hour. Several types of portable machines have been put on the market to relieve this situation.

One of them is a moving platform on wheels. Handled by a force of half a dozen men, it can do the work of thirty, eliminating confusion and avoiding the delay of unloading hand trucks. One of these conveyors is one hundred and forty feet long and is made up of seven sections. It can move one thousand, five hundred boxes of eighty pounds each every hour.



A barrel loader for placing barrels on freight cars or onto high platforms. The apparatus can easily be rolled from place to place as shown on the right



For the benefit of warehouses and manufacturers who find it necessary to stack large quantities of bags and boxes, a stacking machine has just been put out. It is an inclined moving platform supported on an iron frame equipped with rollers, making the apparatus "portable." It is physically impossible for men to stack heavy bags very high up. The new machine, however, is designed for heavy work. It can handle three hundred and forty-pound sacks and stack them up as high as fourteen feet and six inches. It is also used for "breaking down" piles when necessary..

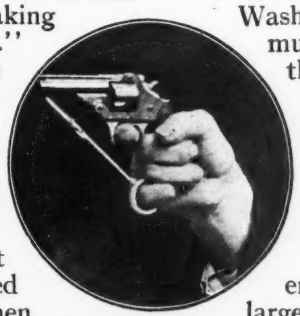
The quick loading of barrels has also been solved by machinery. A barrel loader, which can handle five hundred-pound barrels at the rate of one hundred and eighty an hour is coming into use in plants where barrels are the principal shipping containers. The loader is designed for use in putting barrels into freight cars and onto high platforms. It is constructed on an iron frame and is provided with wheels so that it, too, is portable.

All of these machines are equipped with electric motors to furnish the power. They are so light in weight that they are easily transported from one place to another by one man. The amount of current necessary to run them and the cost of operation are comparatively small.

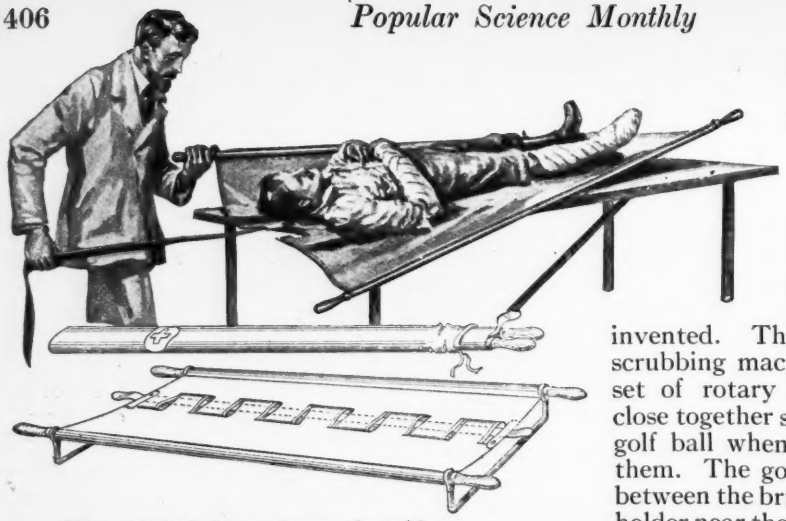
A Simple Device for Taking the "Kick" Out of a Revolver

THE ability to shoot straight with a revolver is a gift possessed by very few. It is easy enough to sight accurately along the barrel, but the "kick" of the revolver causes the barrel to swerve.

To obviate this, John E. Webster, of Washington, D. C., has invented a muzzle controller which prevents the revolver from jumping upward when the trigger is pulled. To the under side of the barrel at the end is welded a flange, similar in appearance and size to the sight above it. Attached to this is a flexible cord. At the other end of the cord is a metal ring large enough in diameter to slip readily over the little finger on the firing hand. The length of the cord is regulated to suit the person firing the revolver, the idea being that when the weapon is raised to shoot, the cord is held taut and consequently it is impossible for the revolver to swerve.



The cord prevents any kickback



The patient is lowered upon the table or bed, the center strap is withdrawn, and the two halves of the stretcher separate

A Reversible Stretcher with Two Dovetailing Sections

THE trouble with most stretchers is that the patient has to be moved from the stretcher instead of the stretcher being removed from the patient. The accompanying illustration shows a new stretcher which parts in the middle, permitting the patient to be lowered upon the operating table without disturbing him. The two halves of the web are merely drawn away from under him.

The two parts of the stretcher are toothed, and dovetail into each other. A strap, which passes through the indentations, holds the web securely together until it is withdrawn. The stretcher can also be reversed and carried upside down when used in close quarters. This one feature enables it to be used with seven inches less headroom than other stretchers.

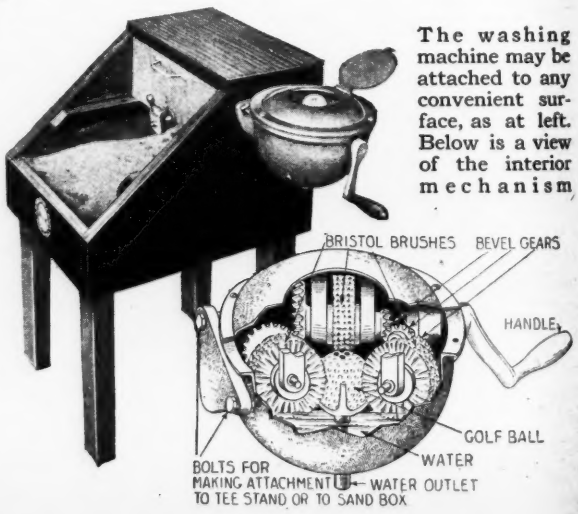
Sacrificing Diamonds for Accuracy in Manufacturing Automobiles

ENOUGH diamonds are sacrificed each year in the average automobile factory to fit up a dozen kings' crowns! Quantity production of automobiles requires that every one of the thousands of parts turned out by machinery must measure up to a high standard. Only then will the parts of the assembled automobile work together smoothly. The emery wheels, used for rapid finishing, must be "trued up" with corresponding accuracy. Nothing less hard than the diamond can be depended upon for this "truing."

A Golf Ball's Washing Machine

THE unfortunate golf ball often becomes covered deep with mud, and drastic measures are needed to get it clean. That explains why the machine pictured has been invented. The appliance is like a scrubbing machine. It consists of a set of rotary bristle-brushes placed close together so that they enclose the golf ball when it is placed between them. The golf ball is pushed down between the brushes into a cup-shaped holder near the bottom of the machine. The bristles are then rotated downwardly by the turning of a handle which connects with the brushes by bevel gearing, as shown in the accompanying illustration. The stiff bristles pass through water placed in the bottom of the machine, and when they pass over the golf ball they scrub off the mud and carry it down into the water. Moreover, the ball keeps constantly turning and new surfaces are exposed to the brushes, so that the entire surface quickly becomes clean.

The turning may be explained by the fact that the grip of each of the brushes on the ball varies in strength. The brushes that grip harder are able to turn the ball around with them. By turning the handle back half a turn, the scrubbed ball is lifted up so that it may be taken out of the machine. The machine takes up a space of only nine by five inches.



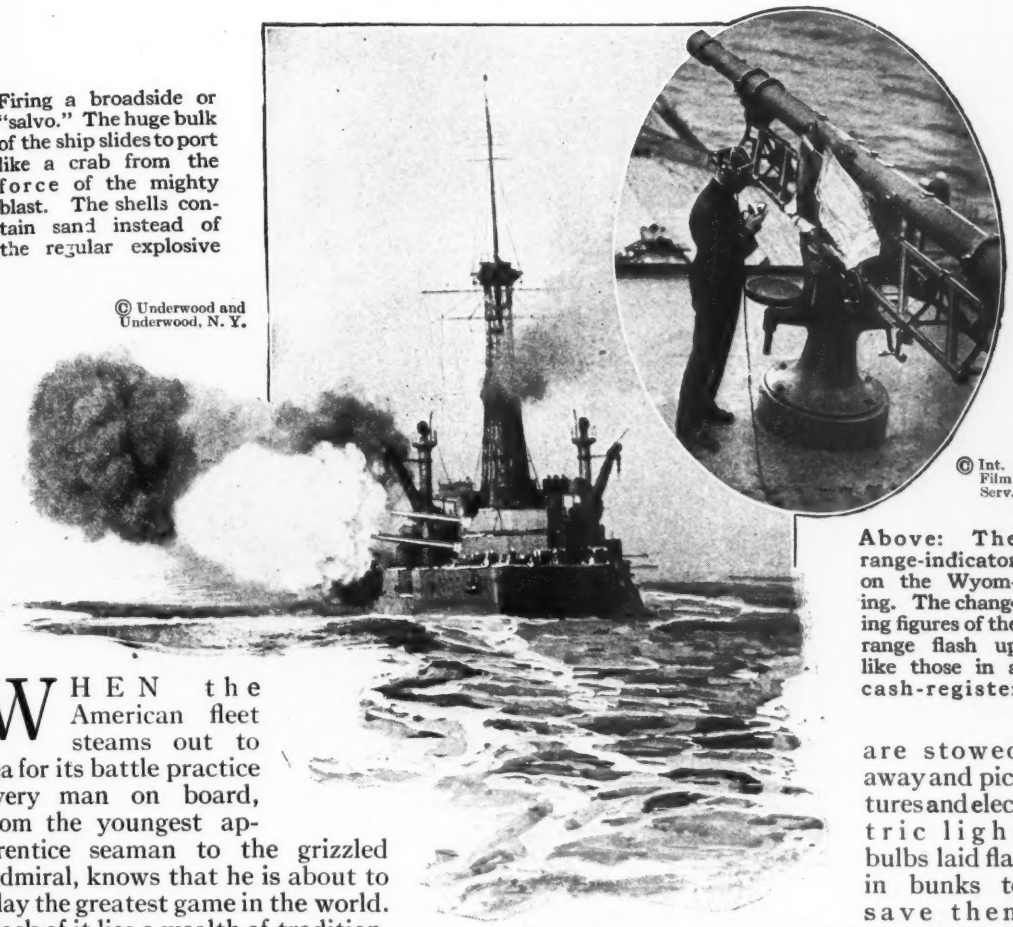
The washing machine may be attached to any convenient surface, as at left. Below is a view of the interior mechanism

The Greatest Game in the World

How the fleet at battle practice hits the target at seven miles

By Captain Frank E. Evans

United States Marine Corps



Firing a broadside or "salvo." The huge bulk of the ship slides to port like a crab from the force of the mighty blast. The shells contain sand instead of the regular explosive

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Above: The range-indicator on the Wyoming. The changing figures of the range flash up like those in a cash-register

WHEN the American fleet steams out to sea for its battle practice every man on board, from the youngest apprentice seaman to the grizzled Admiral, knows that he is about to play the greatest game in the world. Back of it lies a wealth of tradition. No other game can approach it in science, in the millions invested, or in thrills. It is played with the gray steel tubes of twelve-and fourteen-inch guns that serve up thousand-pound projectiles.

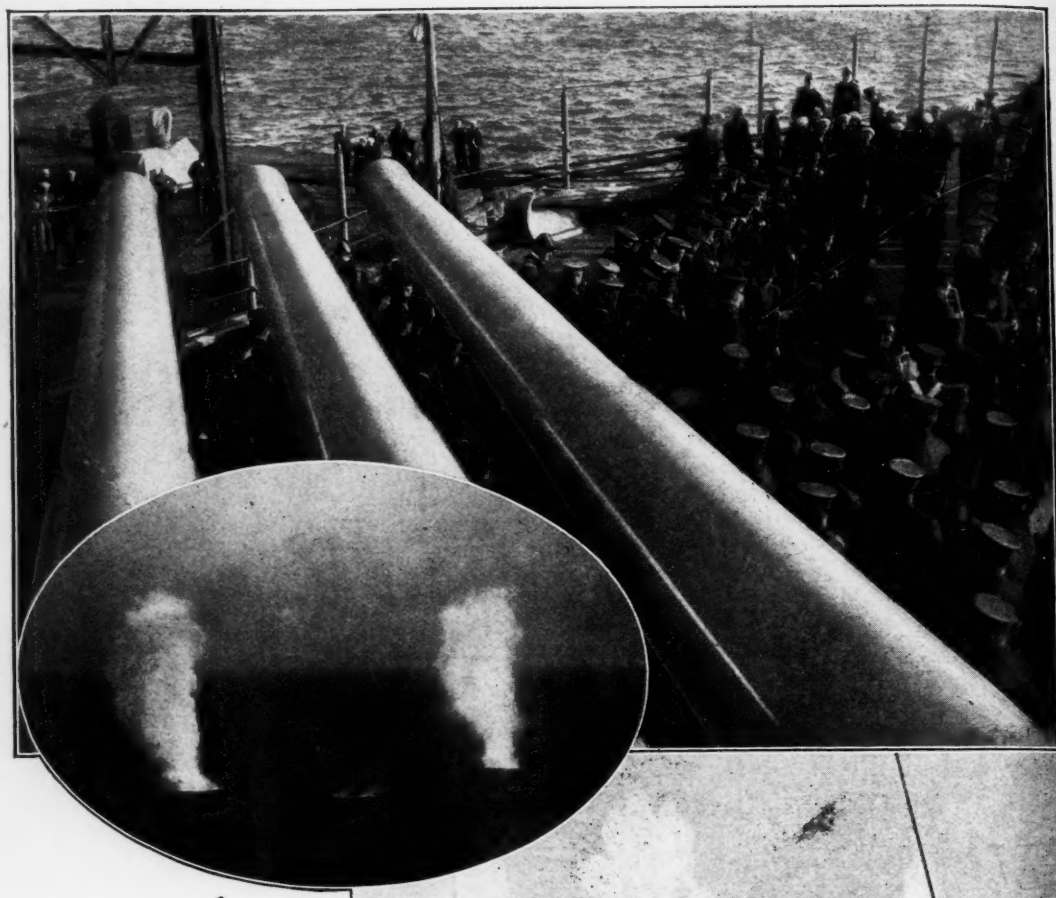
The game is the culmination of months of patient practice. The reward is the privilege of painting a three-foot white E, meaning "Excellent," on the winning turrets and, for the champion of the fleet, a red pennant with a black ball in its center to be flown at masthead for a year.

When the fleet steams out past the Capes of the Chesapeake to its favorite playing ground, rails and stanchions are unshipped, ladders housed and life-lines rigged along the bare decks. Cabin doors are stowed away and pictures and electric light bulbs laid flat in bunks to save them from the guns. Boats are swung inboard and "nested," the smaller ones in the larger ones. If you walk about the decks, you will see vegetable lockers, boats, crates and all wooden gear tagged "overboard." And over they would go in a real battle

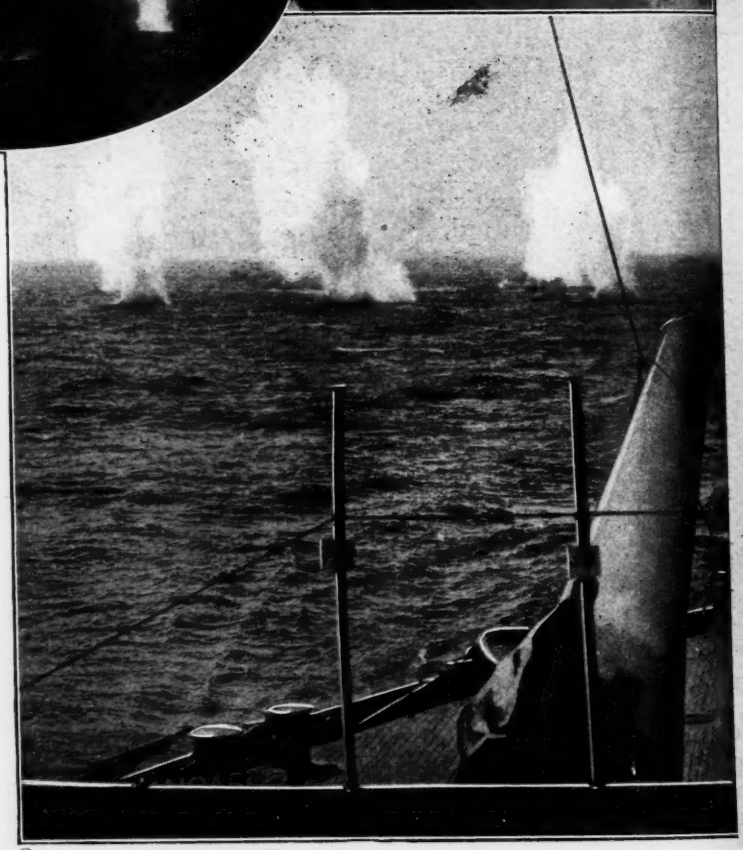
The Fleet Swings Into Action

The fleet steams out at night in two divisions. At morning the enemy division is out of sight below the horizon. Behind her each battleship of the defending division tows, in the column steaming at eight knots, a target a scant four hundred yards astern. Scouting with seaplanes and destroyers, the enemy have found your division. Spirals of their smoke curl up on the skyline. On they come at twice

The Great Twelves and Fourteens Lunge



At top: The greatest game in the world is played with gray steel tubes of twelve and fourteen-inch guns that serve up thousand-pound projectiles. These travel at one half mile a second and throw up cascades of white water that can be seen nearly ten miles away



In oval above: The shell splashes into the water just short of the target and tosses a whirling column of white spray into the air. You can easily follow it (picture on right) as it tumbles along, striking the water again and again, and skimming across the sea in great bounds

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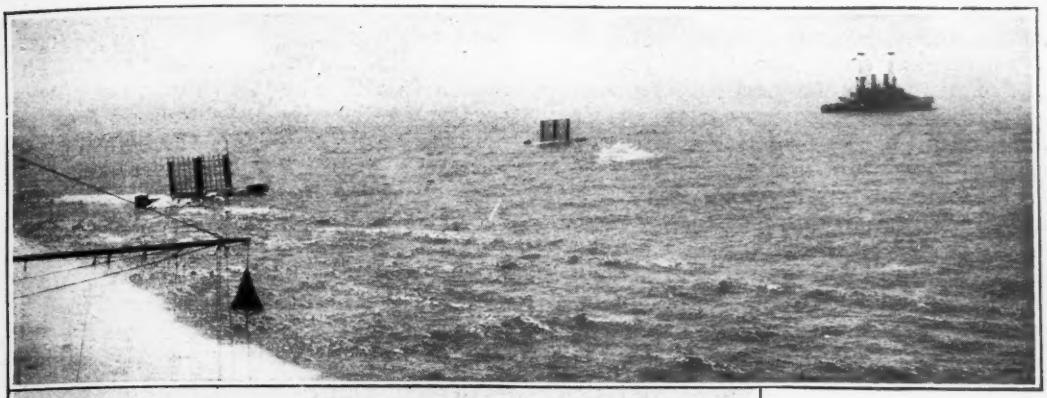
and Roar as Though the Battle Were Real



Above: Behind her each battleship of the defending division tows a target at eight knots. The target is a scant four hundred yards astern—uncomfortably close when the big fourteen-inch guns are trained on it. Two targets are towed by this ship

In center above: Although the big shells are striking just four hundred yards astern, the errors in the range are either "shorts" or "overs." Lateral errors are rare. The photograph shows a sailor signaling to the range-finder a shot "short" of the target

Picture continued from opposite page. Two vivid flashes from the enemy ship and two shells "straddle" the target, one just short and the other just over —a perfect shot for range. After striking the water the shells ricochet and bound two hundred feet in air

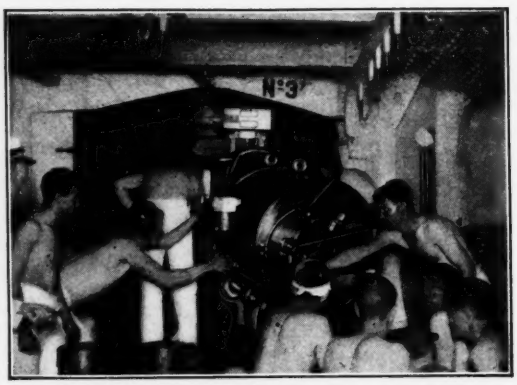
your speed, their funnels belching black smoke, their bows white with foam.

The leading enemy ship is making ready to fire on the target towed by your leading ship. Somewhere between eight and ten miles off to port you see a blinding-white sheet of flame leap from her starboard side. A cloud of smoke hugs the water alongside her. A hundred express trains seem to rattle and roar and thunder. Her shell smashes into the water just short of the target and tosses a whirling column of white spray to the height of your fighting-tops. The shell ricochets. You can easily follow it two hundred feet up in the air as it tumbles along, strikes the water again and then skims across the sea in great bounds, like a stone thrown by a boy over a pond.

Straddling the Target

The next volley may be by pairs, or by "salvos," as the Navy now calls the oldtime broadside. There is no danger though; for in battle practice the explosive charges of the shells are withdrawn, and sand takes the place of the powder. Although the big shells are striking just four hundred yards astern, the errors in the range are either "shorts" or "overs." Lateral errors are rare.

Next you see two vivid flashes from the enemy ship. The two shells "straddle" the target, one just short and the other just over—a perfect shot for range. Now comes the salvo. One shell tears through the target; another cuts away one of its stays; and a third hits the raft itself. The deep keel, drawing as much water as that of a dreadnought, is all that saves the raft from toppling over. There comes a minute's lull. The enemy ship has fired all the shots allowed her starboard battery. She turns on her heel to bring her port battery to bear on the luckless target.



Stripped to the waist the casemate crew keep the big guns bellowing at the target as it moves through the water miles away

Now comes the counting of hits, the repairing of targets and their transfer to the enemy division. Under cover of darkness, your division steams away to take the rôle of the enemy the following day.

The first gun is fired from your after-turret the next morning when you have come within effective range, and the twenty-seven thousand tons of steel under your feet rock to its single blast. The range is over. The next is short. The third throws a mass of spray over the target, whereupon the ship cuts loose with a salvo of four guns. The huge bulk of a ship slides to port like a crab from the force of the mighty blast.

Within the White-Walled Turret

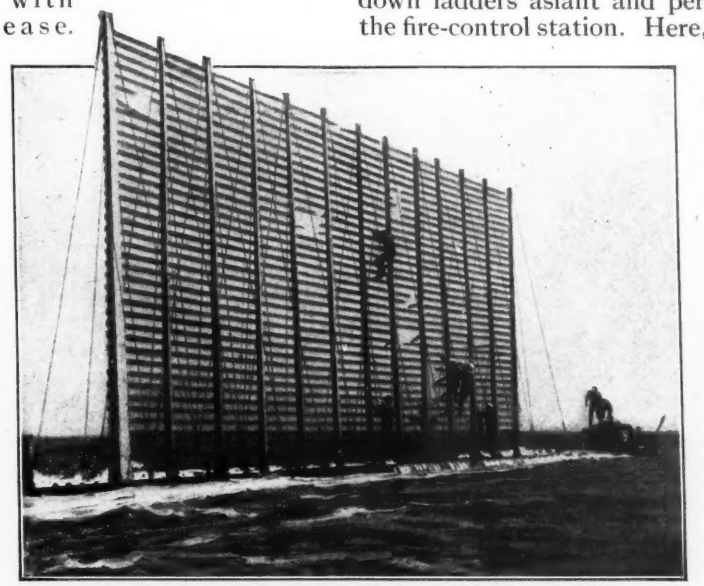
You remember that the after-turret officer boasted, the night before, that in action his turret was the quietest spot on the ship. You clamber up an iron ladder through a trapdoor to pay him a visit. Stripped to the waist, the turret crew grin at your intrusion, and the turret officer, a twinkle in his eye, motions you onto the small platform between the breeches of his two twelve-inch guns. Just forward, on either side, is a space the length of a trolley car and twice as wide. The interior is white as a cloister and just as clean, with walls lined with piping, brass tubes, electrical dials, and odds and ends of gear.

Just above you behind the turret hood one man, the "trainer," by electricity keeps the immense turret constantly on the target. On the outboard side of each of the twelve-inchers is the "gun pointer," who keeps his gun on the target by the use of a single lever. His eye is glued to the rubber eye-piece of his telescopic sight; the slim cross-wires of the telescope must always be intersecting the black bull's-eye in the center of the target miles away. The lenses magnify the target for him, and he follows it as unwaveringly as a hawk follows its prey.

Loading the Big Gun

An electric gong rings. The ensign in charge bellows "load!" The crew, idle a moment before, seems to go mad. From the handling room below, which opens out on the magazine-hoists, bluejackets and marines send up the ammunition-car with a slam and a bang. The big shell is pointed into the breech, sliding over a brass tray that saves the sharp point from "burring"

the lining of the gun and gives forth no dangerous spark to the rasp of the steel. From the rear an electric rammer untelescopes, shoves the shell home with a thud, and withdraws with a bang. Powder-bags, cased in silk lining, and weighing an even hundred each, follow the projectile in the same fashion. The loaders seem to handle them with ridiculous ease. Sharp orders ring out above the roar. The plug swings home. A tiny red light flashes where the gun pointer stands abreast of his piece. Bells jangle. The ensign bellows again. Then follows a dull roar, and the turret quivers and reels like a great wounded giant.



The deep keel of the target, drawing as much water as that of a dreadnought, is all that saves the craft from toppling over when the twelve-inch shells from the enemy fleet pepper it

The next time, you screw up enough courage to place your eye at the periscope between the two guns. A streak of rust color drifts by—the powder gases. The field of your sight clears and dulls again when the mighty hiss of compressed air blows through the muzzle the unburned particles of powder and silk linings of the bags. Before this safety device was adopted a blazing bit of silk lining blew back out of one of the *Missouri's* guns, and fell on the powder bags below. One of the worst accidents of the American Navy followed the explosion.

"Spotting" the Dropping Shells

The field of vision clears again, just in time for you to see the splash of the falling shell. Up in the fighting tops the keen-eyed spotters have not only caught that but have even followed the shell itself in its flight, and have telephoned down to the fire control station the range for the next shot.

The rammer has leaped out again, and, before you have time to realize it, the turret reels to a pair of shots. You see the twin guns driven back three feet in their recoil and then return to "battery" with smashing thuds. The plugman swings his plug handle like a mad dervish, the seventeen hundred-pound breech blocks swing open, and another projectile is rammed home.

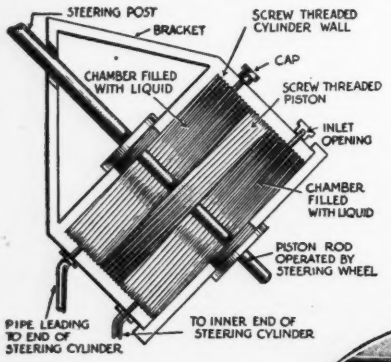
Make your way below, deck after deck, down ladders aslant and perpendicular to the fire-control station. Here, almost out of hearing of the big guns, is the Old Man Courtney of the river, the Hurry Up Yost of the gridiron. Every order to every gun goes through him. The walls of his station are painted a light blue and bristle with piping, brass speaking-tubes and switchboards. There are range-indicators, in which the changing figures of the range flash up like those in a cash-register.

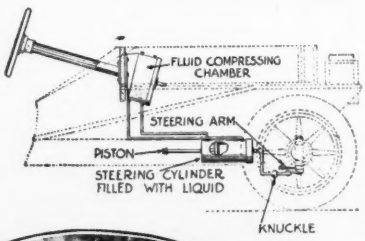
How They Tell What Would Have Happened in a Real-Battle.

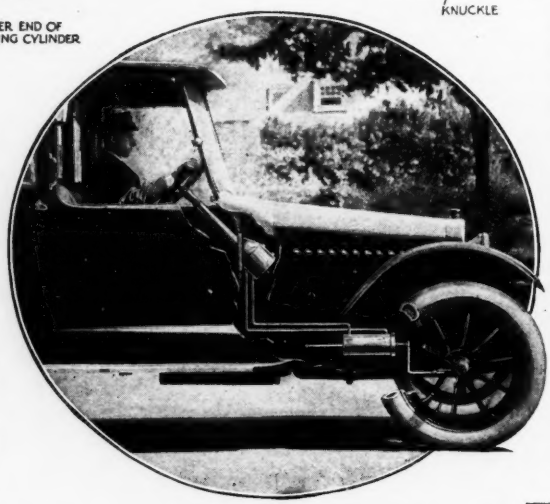
From the after-turret you have just left comes word that spray is dashing on the turret's telescope, and the foretop reports that the target is obscured in heavy smoke from the towing ship. The navigator reports the bearing of the ship and that of the target, and the "spotters" send down their estimates of the range. The umpire, on a neutral ship, opens his sealed orders and tells the fire control officer that his foretop is smashed by an enemy shell and that no further help can come from that direction. Away goes the after-top. The rest of the battle must be fought out with the help of the "spotters" stationed on top of boat cranes and turrets and on the flying bridge. An order is flashed for a starboard salvo. When word comes of a clean hit the range is flashed from stem to stern of the ship. Finally the bugles shrill out "cease firing!" and the great game is over.

Operating an Automobile Steering Wheel with Oil Pressure

THE tendency of the conventional automobile steering wheel to jump out of the hands of the driver when negotiating uneven streets or roads full of ruts is corrected by the novel device shown here-with. It accomplishes its purpose through the flow of oil between two inter-connected cylinders and pistons.







Above: Details of the device for preventing the steering wheel from jumping out of the hands of the driver over uneven rough roads

At right: A cut-away illustration of the device in operation showing how the wheel is connected with the cylinder piston rod

The lower end of the steering wheel column is attached to the end of the piston rod of the first cylinder, mounted on the forward side of the dash, under the hood, as shown. The interior of this cylinder is screw-threaded, as is also the piston which works in it. A filling tap is provided at the top of this cylinder near each end for the admission of oil or other suitable fluid. Similarly placed outlets are provided at the bottom, with pipes leading to the second cylinder which is supported from the vehicle frame near the front wheels so that the forward end of its piston rod may be connected to the usual steering arm in a suitable manner.

In operation, the turning of the steering-wheel moves the threaded piston in the first cylinder, compressing the oil ahead of it and forcing it into one end of the second cylinder. This causes a movement of the second piston and with it a movement of the steering arm and the wheels attached to it. A reverse turning of the steering wheel turns the vehicle wheels in the opposite direction.

Any shocks communicated to the vehicle wheels will be transferred to the piston in the thread engagement with its cylinder. Part of the shocks will be taken up in the oil itself. Due to the larger volume of the first cylinder, a small movement of its piston will cause a relatively greater movement of that in the smaller or second cylinder.

By this arrangement the automobile can be made to negotiate the roughest roads and the deepest ruts without causing the driver to lose control of the steering wheel. The amount of jolting and the consequent wear and tear on the mechanism are also greatly reduced.

In What Position Does a Rifle Bullet Return to Earth?

IN order to solve the problem, a special stand was erected in Germany recently, and experiments were carried on along the shores of a lake, the surface of which was frozen. The ice was covered with strong planks. It was shown that an infantry rifle bullet shot upward in a vertical direction passes downward in the same position in which it passed upward—in other words, it came back again to earth with its bottom first.

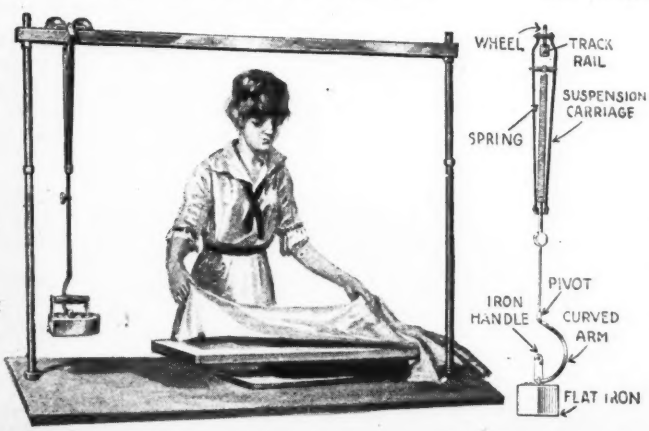
Why was it not upset at its culmination point? The answer is that the propelling force ceases to act at the culmination point. But the twist has as yet not stopped, and therefore it starts its fall with a twist. Even on impact the twist has not stopped, as was indicated by the warping of the wood fibers in the planking on the ice.

An Overhead Trolley System for the Hot Iron

THE average housewife has already discovered that the electric or gas iron is a vast improvement over the other types which necessitate walking back and forth between the iron-board and the stove. But where gas and electricity are not available it is still possible to eliminate those many steps taken during the ironing process.

By means of the trolley system shown in the illustration below the iron may be sent back to the stove when it is cold and a hot one brought in its place with "press the button" simplicity and rapidity. Moreover, the iron is held at just the proper height when the hand is removed from it so that no iron-stand is necessary and all lifting is obviated. The saving in energy which this effects may not be so apparent as the elimination of steps, but it is considerable nevertheless.

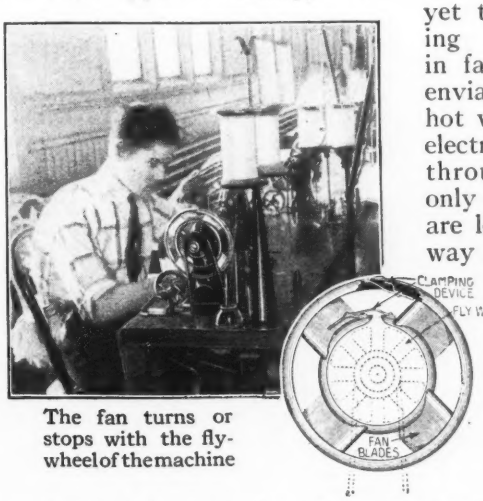
The iron is suspended by a rod from a carriage which travels on a track supported by two end uprights, one of which (the left one) has a spring which permits the iron to be brought down to the job and forces it up out of the way when the iron is released by the hand. The rod from which the iron is suspended can be adjusted to any height desired, so that the iron can be used on ironing-boards of all sizes and heights. The inventor is W. H. Olver, of Oshkosh, Wis.



The iron is suspended by a rod from a carriage which travels on a track between the board and the stove

A Fan on the Sewing Machine —A New Idea for the Factory

ALTHOUGH the "sweatshop" is fast becoming nothing but an unpleasant memory, even in the largest of cities, yet the life of the sewing machine operators in factories is far from enviable, especially in hot weather. Even if electric fans are installed throughout the place, only the lucky ones who are located in the pathway of the breeze are benefited. But Lyle D. Corey, of Minneapolis, Minn., has evolved a plan by which each individual operator may be kept cool and as comfortable as possible during the sweltering heat.



The fan turns or stops with the flywheel of the machine

He has invented a fan which is attached to the flywheel of the sewing machine. The fan is composed of two circular rims, between which fan-blades are pivoted. The inner rim is channel-shaped and fits over the flywheel. A lever and links are provided for contracting the rims to fit over the flywheel and for limiting the movements of the fan-blades so that the air currents may be controlled. The fan is easily detached when not required for use.

Flint-and-Steel—The Matches of Yesterday

BRANDON, a small town in Suffolk, England, still supplies the world with flint-and-steel tinder boxes, which even the developed friction matches of to-day have not made obsolete. Elderly persons can still tell us about the time when flint-and-steel were universally used; when old rags had to be charred for tinder, and when the sparks had to fly to get these to catch fire. Brandon flints have always been justly famous. They were used in the kitchens at home, and on cannons in the wars. They saw service at Waterloo, in the Crimean War, and even as late as in the South African campaign. The first one was made in 1827.

A miniature electric railway by means of which half a million pounds of meat are handled daily. Nine hundred cars, driven by seven electric locomotives are used in one packing establishment

Meat Packing with the Aid of an Electric Railway

PREPARING and packing meat products on a large scale requires many thousands of operations in many separate buildings. Since meat is very perishable, it must be carried from one building to another in the least possible time and should be subjected to as little actual handling as possible during the processes preceding refrigeration.

It is in this capacity that the electric railway system excels all other systems, and as early as 1892 one large packing house in Chicago installed a trolley. It consisted of one modest electric locomotive and a few cars, running on three-quarters of a mile of elevated track. With the increase in business, this miniature railroad had to be enlarged. Now there are seven locomotives, nine hundred cars, and double the amount of track. The locomotives have a capacity of twenty-five horsepower, and the power to run them is generated in the company's four thousand, one hundred and fifty horsepower power-house.

The rolling stock consists of small flat-cars, box-cars carrying five tons of beef, and tank-cars for transporting blood, animal-oils and the like. A half million pounds of meat are carried about every day, and no less than one hundred and seventy-five refrigerating freight-cars leave the Chicago yards fully loaded every night.

Making the Aeroplane Tire A Hundred Per Cent Efficient

FIVE years ago, the ordinary large automobile tire was used on aeroplanes. These were necessary to help the machine start from rough ground, and also for protecting the delicate mechanism from the shocks of landing. But compared with the developed aeroplane tire of to-day, these tires seem almost absurd. They were much heavier and they offered much more resistance to the wind. The invention of the cord tire undoubtedly accelerated tire refinement. The tires that are used in the war in Europe, for instance, are as much "alive" and as springy as older types, but they are made smaller in cross-section and lighter in weight. Hence they allow a corresponding increase in weight to be carried.

Curing Rheumatism with Radium

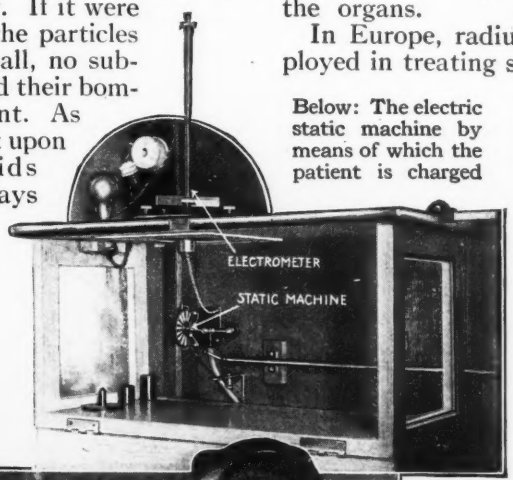
The latest means which European physicians are employing in the treatment of the soldiers in the trenches

By the Paris Correspondent of the POPULAR SCIENCE MONTHLY

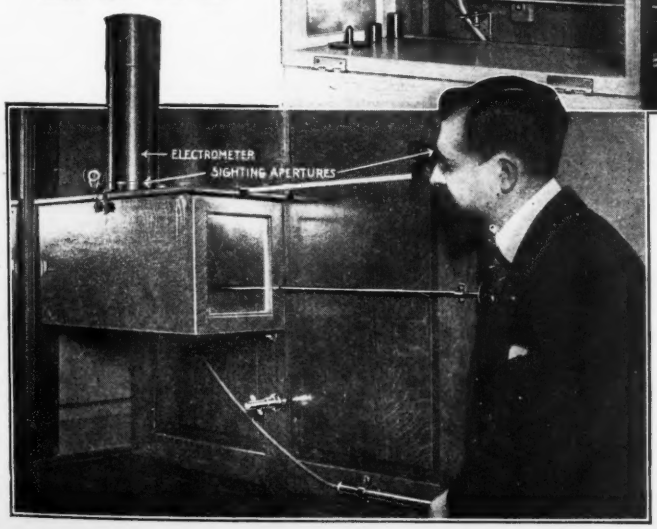
RADIUM stores so much energy in its atoms that a thirtieth of an ounce has wrapped up in it about as much heat as a whole ton of good coal. That is one reason why radium is so puzzling. It is one of the heaviest solids we know—being many times heavier than iron. Yet it is continuously breaking up into an emanation which forms one of the lightest of gases. This emanation is even lighter than air. During the transformation, myriads of electrically charged particles are thrown off.

The particles that make up the emanation are hurled from the radium at enormous speeds. Imagine, if you can, a stream of these particles as they are hurtling through space at a speed approaching eleven million miles an hour! Then try to picture what would happen should anything get in their way. If it were not for the fact that the particles are infinitesimally small, no substance could withstand their bombardment for an instant. As it is, their impingement upon certain dense solids causes brilliant displays of light. Their impingement upon human tissues has a fundamental effect upon the life processes. Like X-rays, which the emanation contains in part, the rays of radium emanation have a curative effect upon certain skin affections. Their direct application in treating cancer, on the other hand, has been found under certain conditions to stimulate the action of the growth rather than the counter-action. But the use of the emanations, after they have once been emitted and consequently have lost some of their force, has been eminently successful in the milder forms of human ailments. Painful conditions brought about by rheumatism and gout, for instance, have been actually cured by applying the emanation internally. The gentler action throughout the system seems to stimulate the organs.

In Europe, radium emanations are employed in treating soldiers who suffer from severe muscular rheumatism because of the dank conditions in the trenches. The accompanying illustrations show the type of apparatus that is used in the treatment of these cases. The patient is placed on an insulated chair inside an air-tight booth, and is charged to a high potential by a small static electric machine. He is then supplied with a steady flow of air, which has passed over a quantity of radium. The electrically charged emanation emitted from the radium diffuses through the air, and certain of its rays are encountered by the patient, who draws them in with his breath. After reaching his lungs, they are almost entirely absorbed by his system, when they begin to effect their cure. During the treatment, the physician keeps



Below: The electric static machine by means of which the patient is charged



The physician is shown placing the radium tube in the booth from which it shoots its emanations into the air

the strength of the emanation in the supplied air at its proper value. For this purpose he uses an electric instrument which he reads through sighting apertures. The instrument is operated by the electrically charged emanation, so that the degree of the activity is indicated by the amount the instrument is affected. The instrument shown in the illustrations—an electrometer, it is sometimes called—can measure the activity in the air to a high degree of accuracy.

The patient, charged to a high voltage, breathes in the electrically charged air

Curing rheumatic ailments by the water of the now famous European springs is a treatment which has come down through many ages. Unknown to the travelers, the success of this treatment was principally due to the action of the radium salts which were dissolved in the springs. When this fact was discovered, the idea immediately suggested itself of using ordinary liquids in which the emanations could be dissolved. The liquids could be charged at stations distributed all over the world, and the treatment made available to almost everybody. This is now actually being done and small iron tanks containing the active liquids can be ordered by mail in Europe.

A Remarkable Rectifier for Charging Batteries on Alternating Current

EVERYBODY knows that used storage batteries can be recharged only on direct current. The automobile owner whose individual garage is supplied with alternating current instead, finds himself handicapped when it comes to recharging his own batteries. He has to take his storage batteries to a service station for recharging.

But a new gas rectifier has been placed on the market which will recharge even as few as three batteries inexpensively. It consists principally of a small bulb filled with nitrogen gas and containing electrodes of tungsten and of graphite. This bulb screws into a socket on a panel of the apparatus like the bulb of an ordinary electric light. The complete apparatus is connected with the alternating supply main, two leads on the other side of it are connected with the batteries, and a switch turns it on.

A Burglar-Alarm for Foiling the Automobile Thief

A PROFESSIONAL automobile thief can break through locks and guards and get almost any automobile started. But one thing he wouldn't count on would be a burglar-alarm clanging with him as he dashes down the street. Such an alarm for announcing his profession to the policemen that he would pass has been invented by William Connoly, of New York city. An electric circuit-closer is mounted directly under the driver's seat and the least pressure on it will close a circuit running to a large bell. All the parts are locked in places that cannot be easily reached, and the thief will be greeted with the clanging alarm as soon as he takes his seat.

Pressure on the seat closes an alarm circuit underneath so that a bell clangs loudly as the thief vainly tries to get away undetected

Blind Boy Athletes

How Dr. Hart taught blind boys to camp, swim, run races and enjoy themselves just as if they could see

They are blind but they can "see" just the same—with their fingers. Here they are constructing a tool and chicken house

ONE of the most notable achievements of the year at the Pennsylvania Institution for the Instruction of the Blind at Overbrook has resulted from the development of a bit of knowledge about the blind which has been current for more than a hundred years—the knowledge that one who loses his sight develops a remarkable sensitiveness in the forehead.

Examination of a human skull shows that the thick, bony substance in the middle of the forehead is really a mass of small cells. For years the blind have told their instructors that they "feel" the presence of others, the nearness of a wall, even a flying missile, in these cells. The sensation is of a sudden density. Little use was made of this knowledge until a year ago, when Dr. Charles D. Hart, of the Overbrook institution, formed the world's first troop of Blind Boy Scouts, Number 108 in the Philadelphia Council.

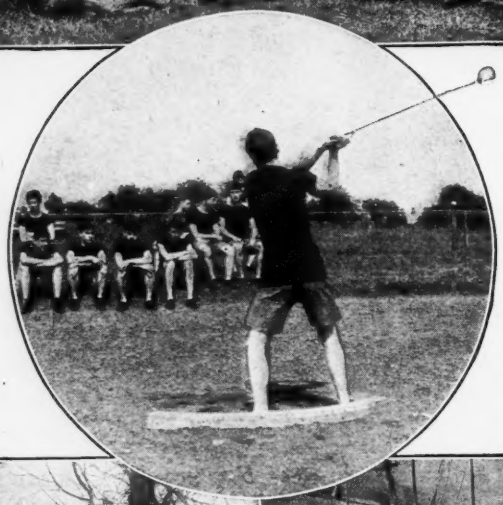
These blind scouts were allowed to camp out just like other scouts. They swam, and went boating. They built fires, went on long hikes, cooked their own meals and set up their tents. But even more remarkable was their ability to travel over rough ground without stumbling. The explanation of this is to be found in muscle balance; it is not a new discovery. It is an extraordinary heightening of the sense of touch in the soles of the feet. But like the other bit of knowledge it never had been put to practical use; in fact, it never had been given a fair test under conditions where the blind could be absolutely removed from the feeling of submission to assistance. Says Dr. Hart in this connection:

"Balance is made up partly of muscle control and partly of the control made possible by the sense of sight and the accompanying judgment of distance. When the sight is gone, the first thing that the blind person discovers upon attempting to stand or walk is that it is extremely difficult to maintain the equilibrium. But Nature quickly compensates for the loss of sight by the increased sensitiveness of the tactile nerves in the soles of the feet.

"While out on hikes with the Blind Boy Scouts I have witnessed a running boy halt for an imperceptible fraction of a second at the edge of a gully, then step into and out of it with all the surefootedness of one who could see. There is but one exception to the ability of the blind to feel their way

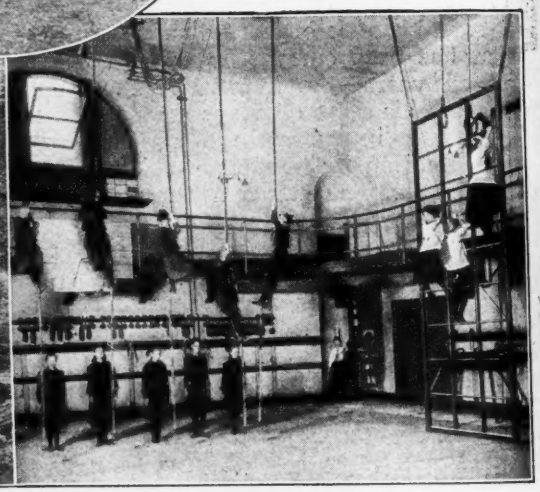
These Pictures of Blind Boys and Girls at Work and

The Blind Boy Scout Troop. The reserve and suspicion which characterized the blind boy has been corrected. Track and field contests have made him resourceful and self-confident. He has been allowed to do things like others



At left: The blind boy's only guide for the direction in which to throw the hammer is the semi-elliptical wooden bar at his feet, which is the same as that used in all hammer-throwing pits. The spectators seem to have no fear of being hit

Cutting up a tree which they felled with their own axes. The blind scouts gather their own firewood, build their own fires, set up their tents, make camp and do their own cooking



A class of girls at work in the gymnasium. They can do everything there that is done by those who can see, and they get equally as much pleasure from the exercise

Play Prove That There Is No Darkness But Ignorance

Blind boys and girls dancing the minuet in Colonial costume. Outdoor entertainments are a regular feature at Overbrook, Pa.

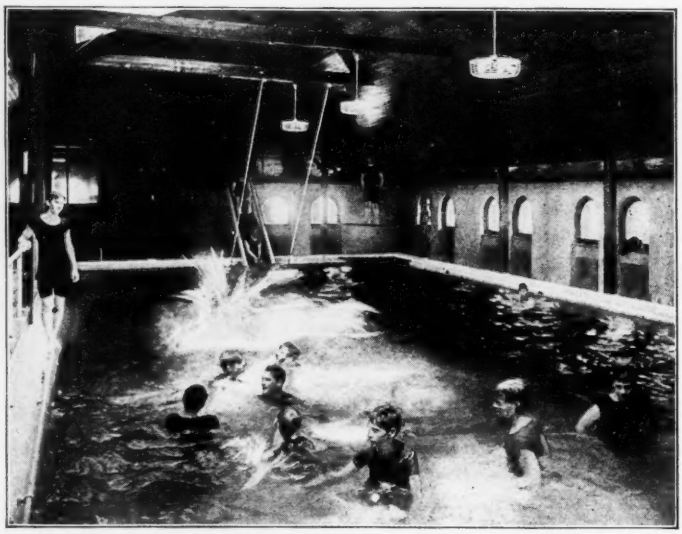
Each student has a garden plot. The blind show as great a love for flowers as do those who can see roses and lilies

The blind runner is guided by the rope but he objects to it. He usually keeps his path by muscle-memory or by instinct

with the feet. The blind person, no matter how familiar with the ground, is completely at a loss when he attempts to walk in the snow, which is often called 'the blind man's fog.' Somehow the soft cushion of flakes destroys the tactile impressions or blurs them to such an extent that the muscle memory is nullified.

"Combined with the muscle memory is an acute sense of direction which the blind develop. When the boys went swimming in the creek they shed their clothing seemingly at haphazard on the banks. But on coming out each boy went unerringly to his own clothing, guided by their sensitive soles."

The track and field events at Overbrook prove that there are expert athletes among the blind also.



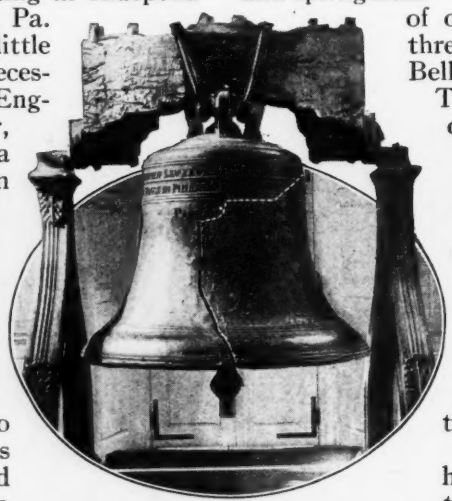
Under professional instruction the blind boys became expert swimmers and divers. Life preservers are obnoxious to them

The Liberty Bell Is Sick and That Is Why It Cracked

METALS have diseases and lose their vitality. They become tired or fatigued, just like human beings, and are weakened as a consequence. That is what ails the old Liberty Bell, resting in Independence Hall, Philadelphia, Pa.

To understand this, a little of the bell's history is necessary. Cast in London, England, by Thomas A. Lester, it arrived in Philadelphia in 1752 and was tested in August of the same year. It was cracked at once by the clapper's stroke. Instead of returning the bell to England, it was remelted and cast again, but ten per cent extra copper was added to it. This seemed to spoil its sound. It was remelted and cast a third time. Tin was added to restore the sound.

The actual quantity of the various metals used is not known, but it is certain that to melt and handle the two thousand pounds necessary at least two dozen of the largest eighteenth century crucibles or melting pots were required. Evidently the bell could not have been uniform throughout. It did not cool evenly, and so, what are known as shrinkage strains were set up. It is just as if enormously powerful hands were constantly trying to tear the metal like so much paper. As a result, the first large crack which is so prominent to-day appeared.



The first crack extends about two thirds of the distance from lip to top. The second is shown by the dotted lines

One disease of metals is due to too much remelting. It seems that their life is destroyed, their real value burned out of them. Tests made in remelting copper several times under the best conditions have shown that with each melting the metal loses largely in tensile strength and springiness. Bending tests show a loss of over fifty per cent from three meltings. The Liberty Bell was recast three times.

Tin is also known to be often afflicted with the "tin pest." Particularly in a cold climate does it seem to finally turn gray and crumble. Organ pipes in a church in Lietz, Prussian Saxony, Germany, decayed in 1851. They were afflicted with the tin pest. There is tin in the Liberty Bell, too.

Our sacred national relic has probably had more trips over the country to various fairs and exhibitions than any other in

this or any other country. Had it been allowed to remain at rest after the disease had shown itself in the great crack extending about two-thirds of the distance from the lip to the top, being stopped by the somewhat thicker metal of the word "Philadelphia," as shown in the illustration, the new and more dangerous crack running diagonally around the Bell from the letter "P" in Philadelphia to beyond the letter "Y" in "Liberty" would probably not have occurred. It was not observed until after the bell had made a number of journeys over the country.

It is not at all astonishing, therefore, that our venerable Liberty Bell, having passed through the melting pot three times, and having been doctored by amateurs in metals, should still have symptoms of its old disease.

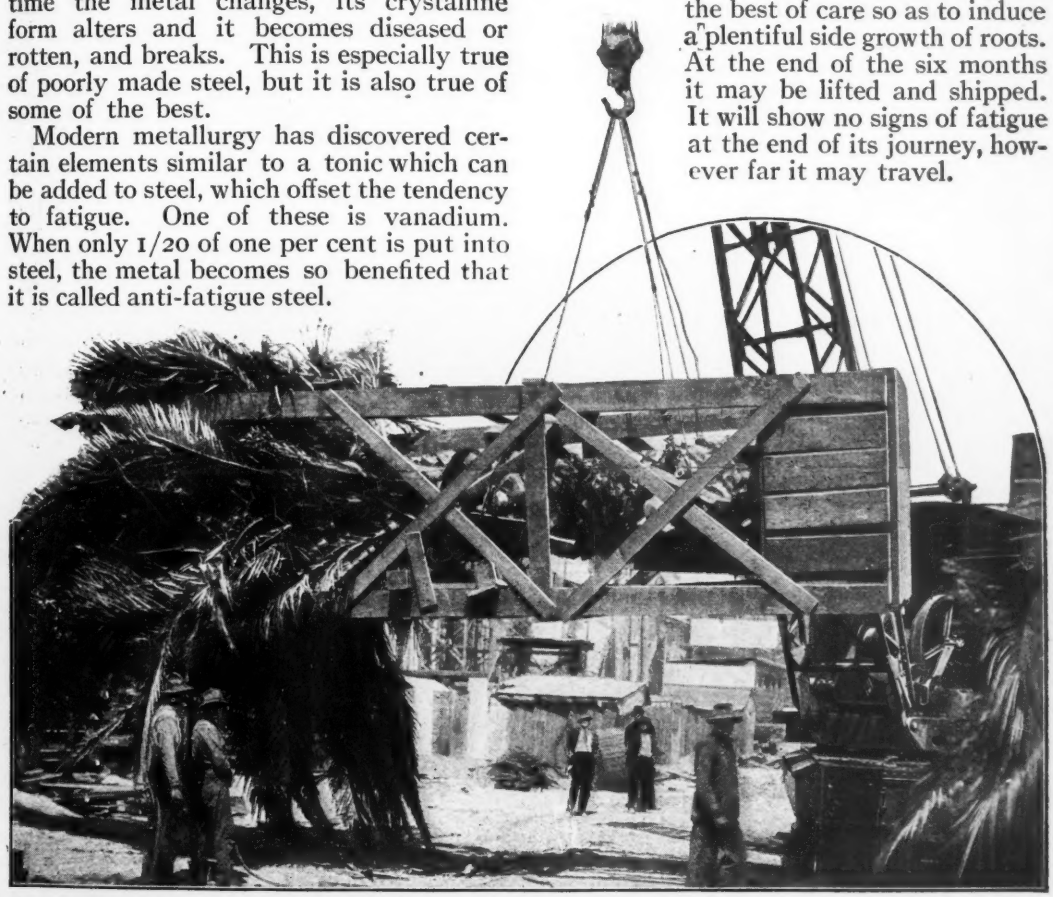
Steel, too, becomes fatigued after long usage and loses its strength. This is particularly true of steel parts that are subject to frequent vibrations and shocks. In time the metal changes, its crystalline form alters and it becomes diseased or rotten, and breaks. This is especially true of poorly made steel, but it is also true of some of the best.

Modern metallurgy has discovered certain elements similar to a tonic which can be added to steel, which offset the tendency to fatigue. One of these is vanadium. When only 1/20 of one per cent is put into steel, the metal becomes so benefited that it is called anti-fatigue steel.

Transplanting Palm Trees Without Sacrificing Their Foliage

IT is almost impossible for even a lettuce slip to be removed from the spot where it has taken root without a consequent drooping and period of suspended growth. But nowadays, great palm trees are uprooted and carried hundreds of miles from their native soil and climate with scarcely a wilted leaf.

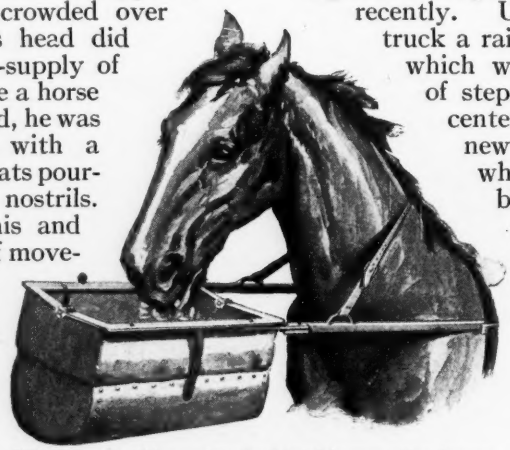
The secret of the success of transplanting such trees lies in the preliminary work. This is begun fully six months before the time for the moving of the tree. First the roots are dug around and carefully cut, and the plant is side-boxed. Three inches are allowed between the balls of roots and the boxing. This space is next filled with earth, which is well tamped down. Thus the tree is made to stand in the box in which it is to be moved, without lifting it from the ground. Here it remains during the six months of preparation. It is thoroughly mulched and given the best of care so as to induce a plentiful side growth of roots. At the end of the six months it may be lifted and shipped. It will show no signs of fatigue at the end of its journey, however far it may travel.



The palm is lifted and shipped without disturbing the roots, for they have been growing in the shipping box for six months in the richest mulch to prepare them for the journey

Making It Possible for the Horse to Eat Comfortably

HEALTHY horses, like all other animals, enjoy a good meal, especially when they can eat it with a reasonable amount of comfort. The old type of feed-bag which was crowded over one-half of a horse's head did not furnish an over-supply of comfort, for every time a horse shook or raised his head, he was sure to be greeted with a suffocating shower of oats pouring down over his nostrils. To do away with this and give a horse freedom of movement while eating, Charles A. Hermann, of Chicago, has devised a new type of feeding-bag. His invention is pictured in the accompanying illustration.



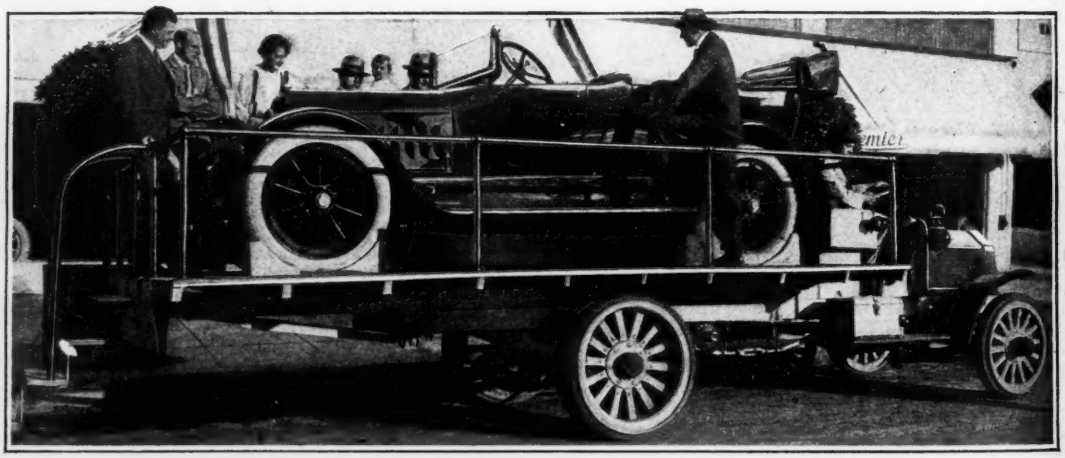
With the feed-bag attached in this way the horse has freedom of action and breathing space

The new feeding-bag is very different from the old, having very much the appearance of an enlarged hand-bag. In this the oats are held suspended in front of the horse from two light rods. These rods are held horizontally in position on each side of the horse by two wide straps. Thus, no part of the device need cover the head of the horse, nor are any of its movements restricted. After feeding time, the device may be unstrapped, the bag closed up, and the rods bent back upon their center hinges, so that very little room is taken up when it is stowed away in the wagon.

An Automobile Salesroom on a State Tour

WITH a four-ton truck as a salesroom on wheels, the firm of Smith Brothers, in Los Angeles, arranged a remarkable selling tour throughout southern California, recently. Upon the body of the truck a railed platform was built which was reached by a flight of steps in the rear. In the center of this floor was set a new pleasure car, with the wheels held securely by blocks so that it would stay in place. The platform was carpeted, as were the steps; the brass work of the railing was polished and the truck was sent from one town to another where it stayed long enough to attract the interest of many prospective buyers. The platform was built wide enough to allow prospective buyers to walk all around the pleasure car while a salesman pointed out its attractions.

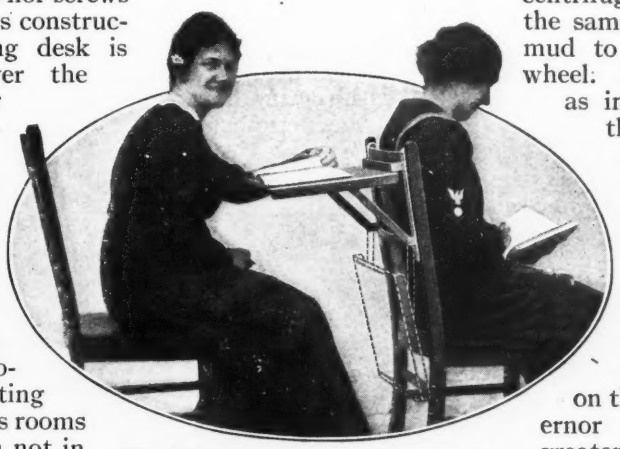
Of course it would have been a simple matter to have sent out the automobile on this campaign without the truck, but the machine would have lost its luster and its new appearance, while by this method the demonstrating car could be kept absolutely perfect. The sight of an automobile mounted upon a truck attracted attention to both the pleasure car and the sturdy truck that carried it.



The sample automobile was mounted on a carpeted platform on a truck and exhibited in all its mechanical perfection and original luster just as it would have been in a showroom

Finding a New Use for the Back of a Chair

A FOLDING desk, invented by a young school teacher, Paul Anderson, of Oakland, Cal., recommends itself for its extreme simplicity combined with exceptional stability. Neither bolts nor screws are employed in its construction. The folding desk is merely hung over the back of any chair without any adjustment.



The desk attachment fits over the back of any chair without bolts or screws

The desk is especially adapted for the taking of notes by students during a lecture, by attorneys or reporters during court proceedings and in fitting up temporary class rooms in schools. When not in use the desk may be left hanging on the back of the chair; or it may be folded into a compact package and easily carried about.

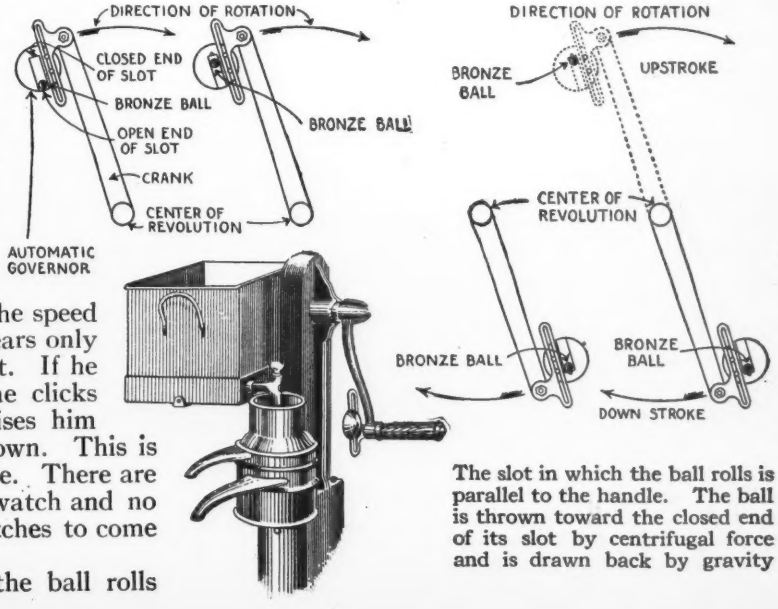
New Cream Separator Governor Is Based on Novel Principles

A STRIKING instance of the simple yet effective in mechanical design is afforded by an automatic governor recently devised for use with cream separators.

This new governor consists merely of a small bronze ball which rolls back and forth in a slot in the base of a bell, the whole apparatus being mounted on the cream separator's handle. If the operator does not revolve the crank fast enough, the bell rings at every turn. When the speed is right the operator hears only clicks—the bell is silent. If he goes too fast, even the clicks stop, which fact apprises him that he should slow down. This is all there is to the device. There are no indicator hands to watch and no erratic brakes nor clutches to come into action.

The slot in which the ball rolls is parallel to the crank handle. One end of the slot is closed; the other is open. In striking the closed end the ball gives forth a "click," while at the open end it rolls against the bell, causing the latter to ring. Two forces act on the ball—gravity, and centrifugal force, which is the same as that causing mud to fly off a buggy wheel. In the same way as in a buggy wheel, this force tends to make the small ball of the governor fly as far outward as it can get; that is, toward the closed end of its slot.

The further out on the handle the governor is mounted the greater will be the centrifugal force operating on the ball, and the less swiftly the handle will have to be revolved in order to get the governor to "click-click" in satisfactory fashion. This fact is utilized in adapting the governor to the different makes of cream separators, each of which requires a certain set speed of its own. If upon timing, the speed is found to be too slow, the governor is merely slid closer in toward the center and the operator turns the handle faster.



The slot in which the ball rolls is parallel to the handle. The ball is thrown toward the closed end of its slot by centrifugal force and is drawn back by gravity

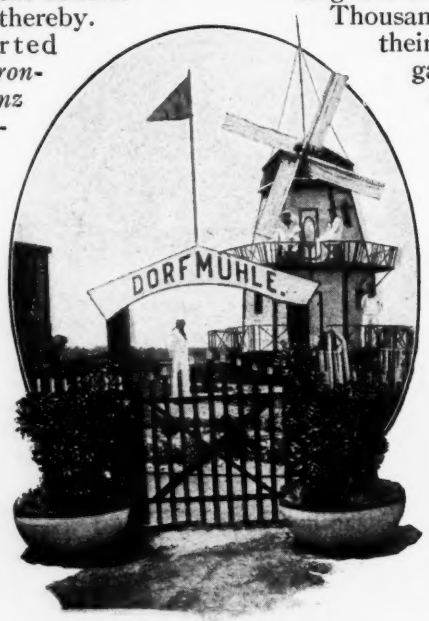
A German Village on American Soil

How the homesick sailors of the interned ships built a real little town with all German conveniences

An interned German and his flock of neutral ducks

THE German village at the Norfolk, Virginia, navy yard is no more, and the whole South is the sufferer thereby.

Ever since the converted German cruisers, *Kronprinz Wilhelm* and *Prinz Eitel Friedrich*, were interned at Norfolk the German village flourished within the confines of the navy yard. But several weeks ago the order came from Washington to remove the big ships to the Philadelphia navy yard. It was sad news for the one thousand members of the crew who had built with painstaking labor the many houses which constituted perhaps the oddest village ever seen in this country. They took their transfer bravely, however. They tore down their houses, packed the lumber and fittings aboard ship and transported the lot, including themselves, to Philadelphia. Now they are busy erecting a newer and bigger German village in the Philadelphia navy yard.



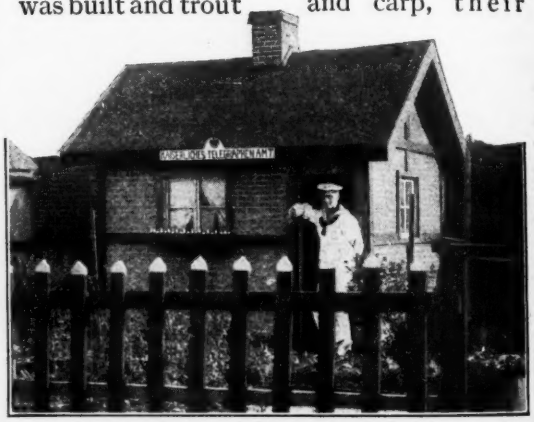
A Dutch windmill and flower garden was one of the sightliest places

Built in front of their ships on a little strip of land set apart for them by the United States Government, the village was amazingly complete. The houses were painted red, green, or blue, and some all three colors. The roofs were of straw, except some of the more elaborate, which were shingled. At each window of the houses hung freshly-starched curtains, and over the doorways appeared picturesque names and sayings, either suggestive of the war or of German folklore. The gardens in front of the houses were surrounded by fences, some of which were original enough in design to set a future style in such enclosures.

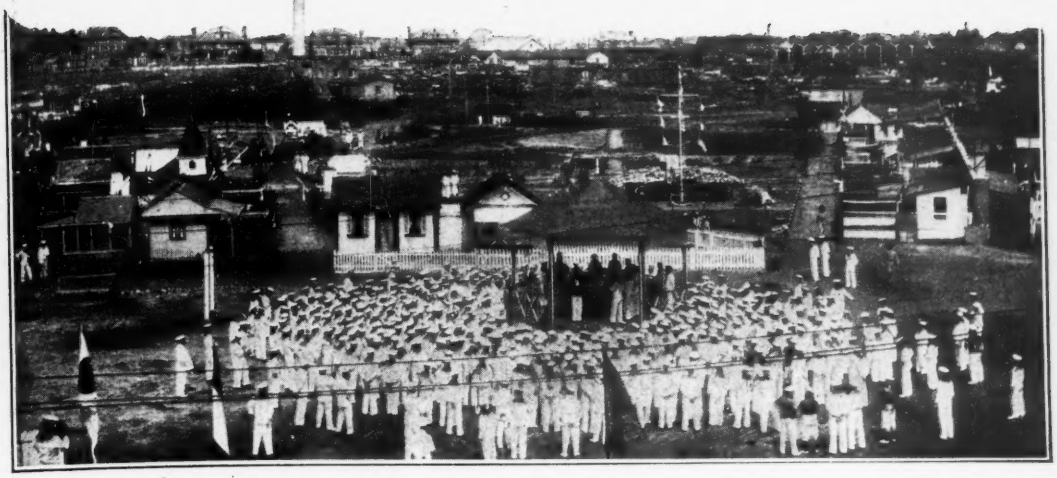
But the German seamen were not content with merely raising flowers. In their spare time they planted oats, barley, radishes, cucumbers, tomatoes and many other vegetables, each gardener trying to surpass his neighbor in the variety of products. Thousands of sun flowers reared their yellow heads above the garden vegetables and gave the village a truly rural complexion.

Plans for the German village were worked out long before the sailors knew where they would be located. During a long winter's session they perfected plans for their village. They made tools out of such materials as happened to be at hand.

The animal mascots aboard the ships—animals rescued from ships that were sunk—were taken ashore and given real homes in the village. There were goats, black pigs from the tropics, rabbits, birds, dogs and cats innumerable. In the officers' garden a fish pond was built and trout and carp, their



A picture of domesticity itself—the telegraph station minus the telegraph



The park and bandstand where the men were reviewed every day and where concerts were given on Sundays. The German village had a population of one thousand

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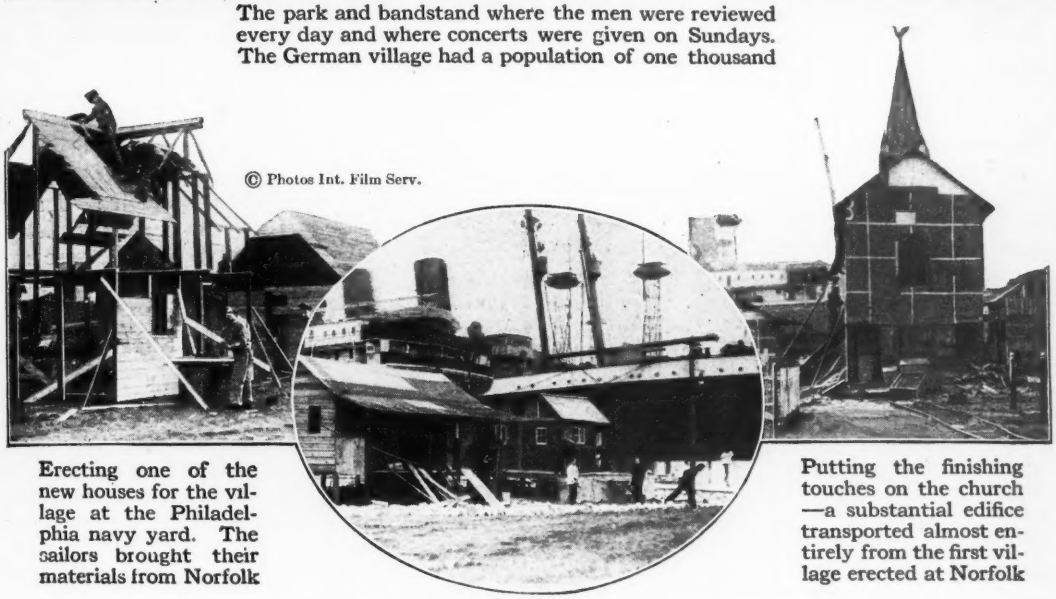


Erecting one of the new houses for the village at the Philadelphia navy yard. The sailors brought their materials from Norfolk

The ships in their new berths at Philadelphia and two new houses under construction. The sailors are not allowed to spend their nights on land

Putting the finishing touches on the church —a substantial edifice transported almost entirely from the first village erected at Norfolk

favorite fish, were placed in the water. The men never were without plenty of eggs, salads and fresh vegetables.

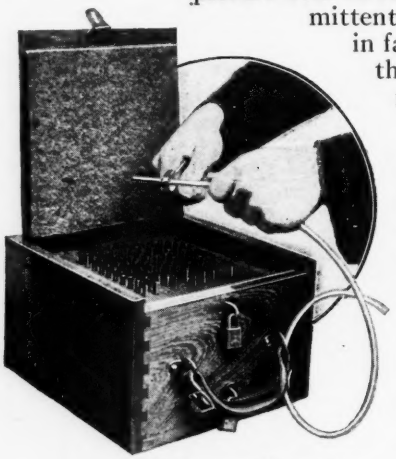
Like all municipalities, the German village had its streets and parks. Straight from the ships ran the *Eitelweg* and *Kronprinzweg* terminating in the *Doeberitzer Heerstrasse*. The *Kurfuerstendamm*, which overlooked *Kap Horn*, the *Mackensen*, *Hindenburg*, *Bismarck* and *Moltkeweg* surrounded the *Kaiser Wilhelm Platz*. Nearby were the officers' garden, the bowling alleys, and the cafes where different refreshments were served, exclusive of alcoholic liquors, in accordance with the state law.

Prominent dwellings were the *Villas Huegel*, *Emden*, *Karlsruhe*, *Tiger* and *Luchs*, the last being given its name in memory of the cruiser *Luchs*, commanded by Captain Thierichens at Tsingtau, Japan, and sunk by him to blockade the harbor before he took charge of the *Prinz Eitel Friedrich*.

The buildings in the quaint village were not limited to dwellings, however. There was a civil marriage bureau with the stork on the roof, a village church, and a police station to keep order among the population of one thousand. A magistrate, Schuettelpost by name, ruled with dignity while the village lasted. His daily orders were posted on a board crowned by a wind-dial made from small ships.

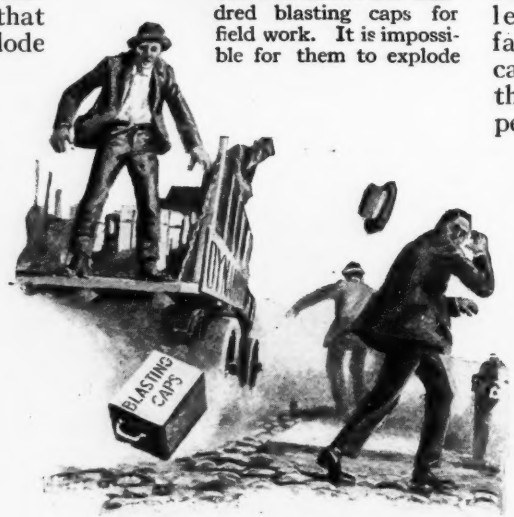
A Safety Box for Carrying Blasting Caps in the Field

WE are becoming so well acquainted with high explosives that we play with them as if they were toys in our hands. In a single year enough explosives are left in public conveyances by thoughtless people to blow up a dozen mines. In the New York subway, for instance, there have been found cans of nitroglycerine, sticks of dynamite, bombs of all sorts and descriptions, and other explosives in sufficient quantities to rock the whole island were they "touched off." All of which goes to prove that some people think no more of toting a death-dealing article about town than carrying an umbrella. Evidently the powder-shy days have passed.



The box carries one hundred blasting caps for field work. It is impossible for them to explode

Not long ago a box filled with one hundred blasting caps was thrown over a fifty-foot embankment into a quarry, where it bounced around on the rocks with no resultant explosion. The fact that the caps did not explode was due to the box in which they were packed—a safety box for carrying blasting caps in the field. Although blasting caps and dynamite never are carried in the same receptacle, blasting caps have caused some serious explosions in the past. Some miners would rather handle a carload of dynamite than a box of blasting caps.



The box can fall off a wagon and cause no more damage than if it contained spaghetti

The new safety box shown in the photograph contains two compartments, one to carry electric blasting caps and the other to carry regular blasting caps for use with fuse. The box is made of oak with a top of pine. It is lined with felt obtainable at harness shops. The cap board is removable but it fits snugly on, the space between it and the caps being padded out.

The Race Between Nature and the Scientific Motion-Picture Camera

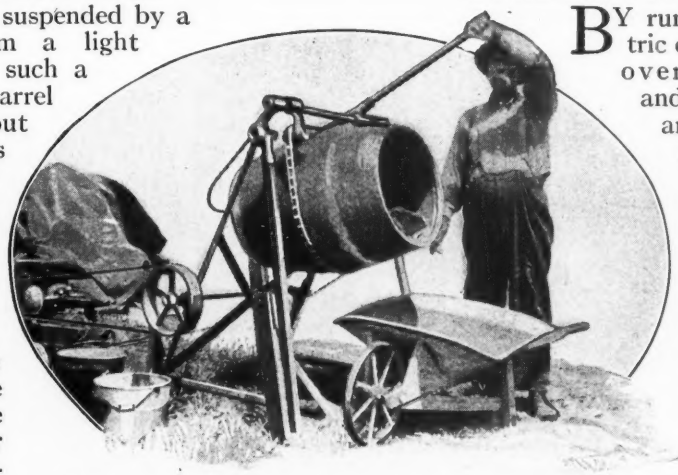
SOME day the scientific camera-man is going to photograph for us the thousands of movements in nature which we have never been able to see because of their lightning swiftness. This camera-man will have a camera capable of taking five thousand pictures per second—or possibly a camera which takes a continuous motion-picture with no revolving shutter and intermittent film movement. He will, in fact, be able to photograph the fastest movements in nature.

In Germany a picture has been taken in one ten-millionth part of a second. The ordinary motion-picture camera takes sixteen pictures a second. This means that a considerable portion of the action is not photographed. In filming a motion-picture drama this loss means nothing; but in scientific research the films would be worthless. At present the fastest motion-picture camera takes pictures at the rate of two thousand per second. Naturally this camera misses very little of the action and shows us many wonders of nature which the human eye has never looked upon.

For instance, take the beat of the honey bee's wing—one of the most rapid movements in nature. A picture taken in a sixteenth of a second misses it completely. But a new camera in which the picture is taken by an electric spark has given us the first view of a bee in flight. A bee was launched almost upside down before the camera, the film showing its efforts to right itself. It regained its equilibrium so quickly that no eye could possibly have followed its movements, but twenty sharply focussed pictures were taken.

A Revolving Barrel as a Concrete Mixer

AN oil barrel suspended by a chain from a light metal frame in such a way that the barrel is revolved about its own axis is the principal part of the concrete mixer shown in the accompanying illustration. The mixer is to be used for the small job where a big mixer would be unnecessary but where hand-mixing would be too slow and expensive to be considered.



Sand, cement and stone are shoveled into the barrel in proper amounts and mixed by revolving the barrel on its axis, water being added during the process as needed

The apparatus is operated by a one and one-half horsepower gasoline motor mounted on a portable carriage. It is especially adapted for the use of farmers or small contractors in the laying of concrete barn floors, house steps, sidewalks and the like.

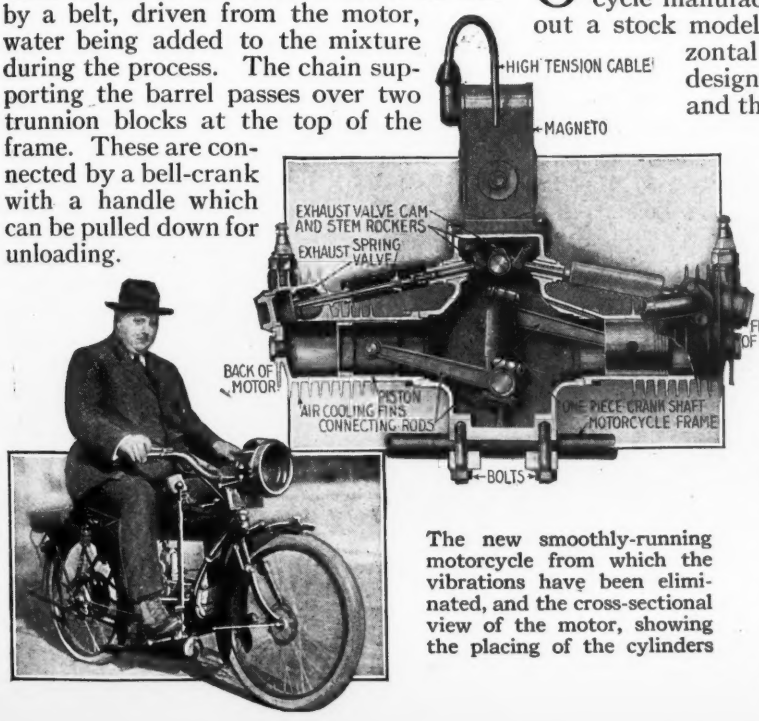
The sand, cement and stone are shoveled into the barrel in the proper amounts. Then the barrel is revolved about its axis by a belt, driven from the motor, water being added to the mixture during the process. The chain supporting the barrel passes over two trunnion blocks at the top of the frame. These are connected by a bell-crank with a handle which can be pulled down for unloading.

What Poor Pavements Cost the Automobile Owner

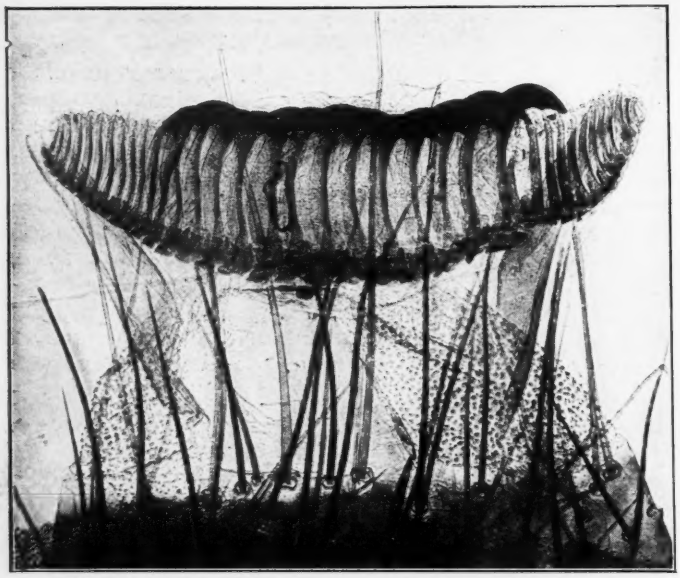
BY running an electric delivery wagon over pavements and measuring the amount of power required at different speeds the condition of the pavement and its resistance to traction have been obtained. At the rate of twelve miles an hour it takes twenty per cent more power to run a car on a poor asphalt pavement than on a good one. On a poor, soft macadam pavement it takes one hundred and twenty-five per cent more power. This taxes each owner about twenty-five dollars annually for roads.

Eliminating the Bumps from the Motorcycle Ride

ONE of the largest American motorcycle manufacturers has just brought out a stock model equipped with a horizontal opposed motor, which is designed to reduce vibration and thereby provide a smoothly running motorcycle at all speeds. The two-cylinder, four-cycle motor has its cylinders placed fore and aft. As shown in the accompanying cross-section view of the motor, the crankpin ends of the connecting rods are attached to a one-piece balanced crankshaft. By this method of cylinder placing, the vibration set up in one cylinder by the reciprocation of its piston is offset by that in the opposite cylinder, and in this way the jolting of the motorcycle is avoided.



The new smoothly-running motorcycle from which the vibrations have been eliminated, and the cross-sectional view of the motor, showing the placing of the cylinders



This looks like some strange vegetable growth, but it is merely a caterpillar, with its tubular legs, magnified

A Mechanical Masterpiece Is the Caterpillar's Wonderful Foot

EVERBODY knows the caterpillar's ability to cling, yet few persons take the trouble to see how it clings. Its body is made up of thirteen segments, on the first three of which are six true legs. But it is not with these that the caterpillar clings. On the ten abdominal segments there are a number of tubular appendages which might be called "pro-legs," each of which ends in a circlet of small hooks, the last two being claspers. At first glance the accompanying illustration might seem to be of a series of feet, but it shows only one foot. The caterpillar in its transformation discards some of its legs and keeps only four. The rear ones are pulp-like, yet they are interesting structurally though not quite so much so as the front legs. The front legs of a butterfly or a moth have evidently been transformed from the front legs of the larva.

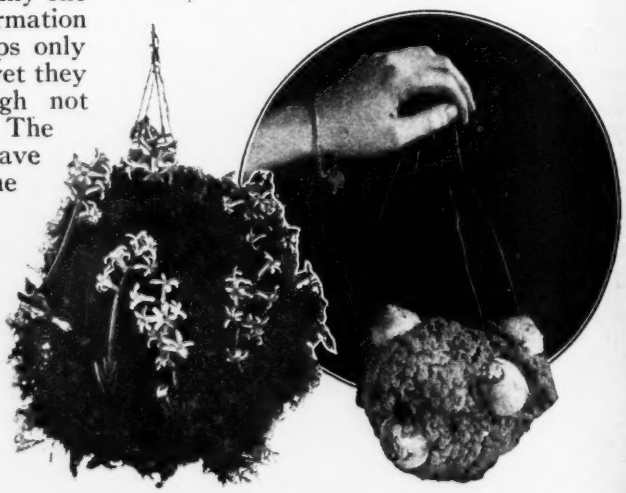
The butterfly never walks, probably because its legs are always weak, being merely supports during rest; but the front legs are not used even for resting. In the larger and heavier species the legs do not bear the weight of the body at all, since the butterfly clings to the underside of a leaf or twig and depends entirely upon the power of suction of his pro-legs and their hooks for support.

How to Make a Hanging Window Garden of Discarded Sponges

A SPONGE is such an ugly thing as it grows flabby from service, that it seems almost impossible to think of it hanging in a bay window or other favored spot as an object on which to feast one's eyes.

But the fact is, that you do not feast your eyes on the sponge, for it is completely hidden from view under a mass of green grass, or better still, of moss, from which you have coaxed hyacinths, tulips, crocuses or narcissi to peep and pour out their fragrance. But the sponge is there and is a most important part of the arrangement. It should be of rather large size. It need not be old; but an old one will serve the purpose as well as a new one. It should be looped around with strong twine or copper wire with lengths extending at the top as a means of hanging it, basket fashion. Now soak it in water and insert your bulbs, two, three or four to a sponge according to the size. Chink it over with moss, if you can, or sprinkle it generously with grass seed as a second choice. From now on the sponge must be kept damp but not wet, and in a dark or shady spot.

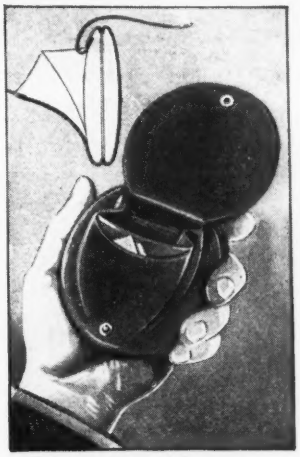
As soon as the shoots begin to appear the sponge may be taken from its hiding place and hung in the sunlight.



At right the sponge is shown with the bulbs just planted. On the left the hyacinths have blossomed

A Tobacco-Pouch and Purse Holder Combined

A POUCH which contains three compartments, one for tobacco, one for money and a third for stamps, has been invented by Charles J. Hathaway, of Walsall, England. The tobacco is carried in the circular compartment which forms a base for the entire pouch. Next is the purse, equipped with a flap, and on the outside is the small pocket for stamps. An outer flap folds over and entirely closes the pouch.

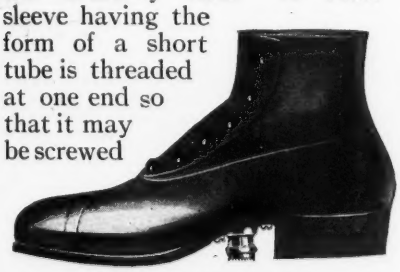


Each of the three compartments is self-locking and entirely independent

Supporting the Arch of the Foot with an Extra Heel

DOCTORS affirm that a great many persons suffer from nervous disorders which arise from slightly abnormal conditions of the feet. These persons unknowingly have fallen arches and the nerves of the legs, stretched as they are, cannot perform their operations normally. Since these nerves are connected through other nerves with the brain, such a condition may result in any one of the nervous disorders. A second heel attached to a shoe would prevent this occurrence by serving as an arch-supporter. An arch-support of the kind devised by Peter Broadbrooks combines the advantages of a "built-in" with those of a detachable supporter. The type shown in the illustration cannot move about under the arch while, like the detachable kind, it can be adjusted to meet the requirements of the wearer.

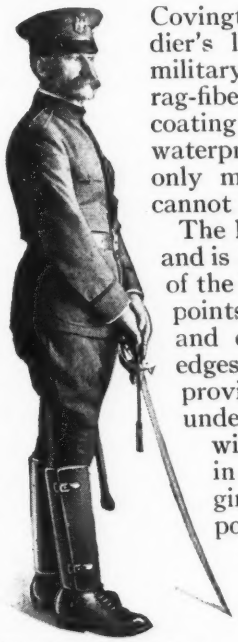
The device consists of a base-plate placed in front of the ordinary heel. A steel sleeve having the form of a short tube is threaded at one end so that it may be screwed to the base-plate. Into this a solid cushion of rubber is permanently fastened, and attached to the bottom of this is a metal plate to give longer wearing life to the cushion. A sleeve of this type is fastened to the shoe, and if the proper height has been selected, it ought to be more comfortable than it ever was before.



The second heel serves as an arch supporter

A Snake-Bite Proof Material for Soldiers' Leggings

THE needs of the soldiers in the trenches and elsewhere have furnished inspiration for numerous inventors. Dr. C. E. Rogers, of Covington, Va., would make the soldier's life easier with a new type of military legging made of vulcanated rag-fiber material, treated with a coating which renders it absolutely waterproof. It is claimed to be the only material which a snake's fang cannot penetrate.



The legging is adjustable at different points of the length to insure a snug fit

The legging is fitted in at the ankle and is shaped to conform with the calf of the leg. It is adjustable at different points of the length to insure a snug and comfortable fit. The fastening edges overlap and a special clasp is provided which includes slots in the underlapping edge. Spring keepers, with enlarged heads, are riveted in the overlapping part of the legging. These slide into the corresponding slots and are secured by metal strips.

The clasps are unlocked almost instantly when desired by means of an eyelet and button. The button moves within the eyelet and is connected with the spring keeper by means of a flange and coiled spring.

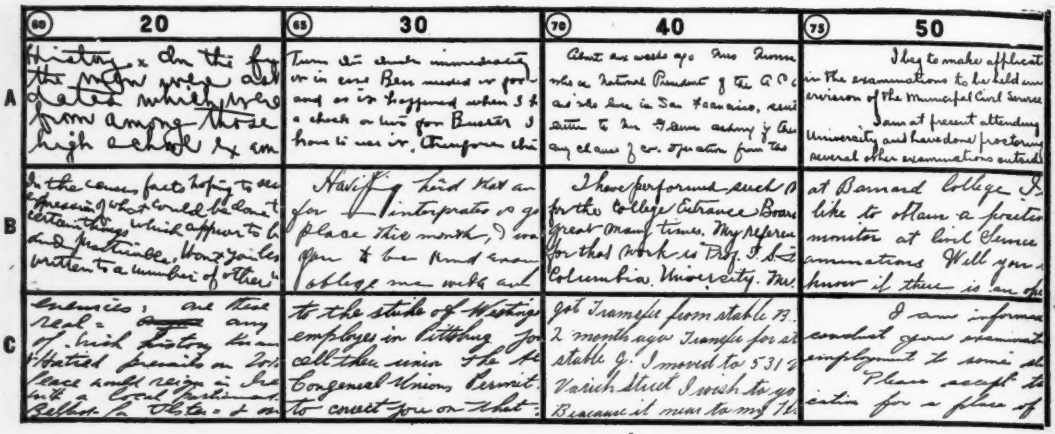
To open the legging it is necessary only to press the button against the spring, so that they are taken off or put on in a moment's time.

Although designed to meet the special need of the soldier, the leggings can be worn by hunters and equestrians generally. They are very light in weight and in spite of their impenetrability are very flexible. They are said to cost about one fourth as much as the ordinary leather leggings. The vulcanated material is adaptable for other uses also, but leggings are the only articles that have as yet been made from it.

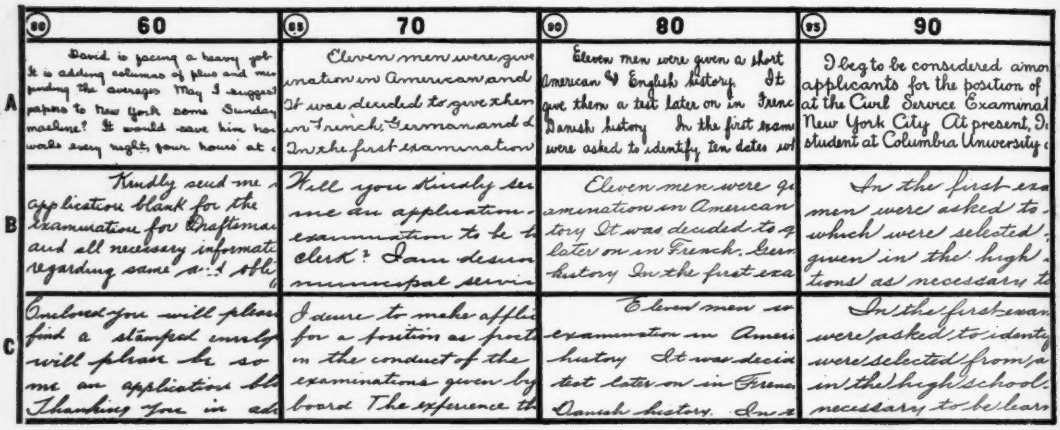
Are You a Good or Poor Penman?

If you can't judge your own handwriting here is a scale which will do it for you

By M. McGuire Telford



To measure the quality of a sample of handwriting, slide it along the scale until a writing of corresponding quality is found. The number in black at the top of the scale above each column represents the value of the writing being measured. Proceeding from left to right note how the samples improve



A STANDARD chart prepared by the Russell Sage foundation in New York city and distributed at a nominal price enables any person to judge easily and accurately his own or another's handwriting. The scale is on a sheet of heavy paper measuring nine by thirty-six inches. It contains twenty-four samples of writing of eight different degrees of excellence. These are of three slants—vertical, medium and extreme. Each of the three slants has eight samples for the eight different grades. Proceeding from left to right each sample is better than the preceding; moreover, the gradations are equal.

The samples are marked at the top 20, 30, and so on up to 90. In actual practice, however, writing is usually marked on a more liberal scale. Grades ranging from 60 to 95 are indicated in the circles at the top of the same samples. The three slants on the scale include more than 95% of the ordinary writing of adults; in fact, 65% of all the samples studied are included in the medium slant.

In measuring the quality of a given sample, the method is to slide the sheet along the scale until writing of similar quality is found on the scale; then a glance at the top of that division tells the grade. Where many samples are to be marked, as in school or other examinations, two methods are used. The first is to compare each sample with the chart as

described. The second, which is more accurate, is to put the papers into piles of about the same degree of excellence and then to compare the specimens in each pile with one another and with the standard. Still more trustworthy results may be obtained by having three persons work simultaneously by either of the above methods; at least two should agree upon the rating.

The preparation of the scale involved many difficulties. This was especially true in getting equal gradations between the eight divisions. Since writing is intended to be read, legibility was made the basis; it is a striking fact that as legibility improves so does appearance. The legibility was determined from the length of time required to read the sample under consideration. In all 15,789 accurately timed readings by ten paid investigators were made with 2,817 different samples.

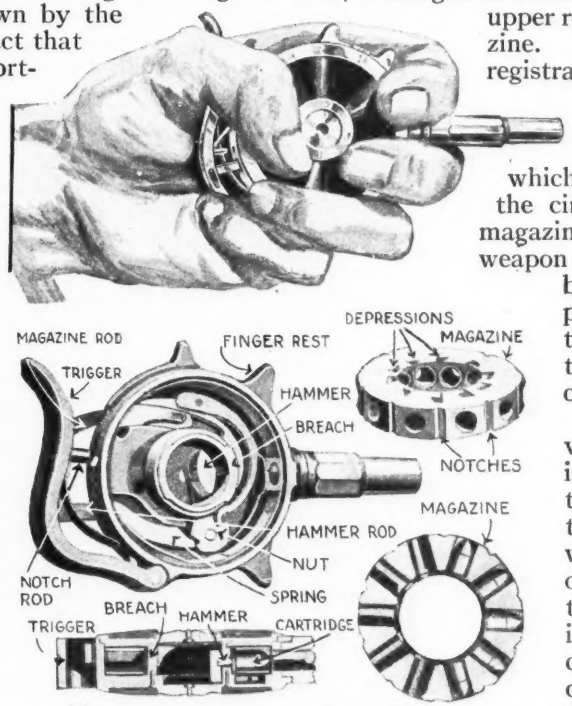
An analysis of samples of writing making a good appearance, but having a low degree of legibility as shown by the tests disclosed the fact that the most common shortcoming is the crowding together of words on a line; next in importance is too little space between the lines. Lifting the pen in the middle of a word so that the word looks like two is also a common fault that leads to illegibility. Failure to dot the "i's" and cross the "t's" also tends to make reading difficult. Some writers insist upon abbreviating the simplest words.

In using the scale it may happen that three judges will rate the same sample 60, 70, and 80. It is possible, however, to come nearer to securing uniformity of grading with the chart than without it; and so far as is known no other equally effective and time-saving means has yet been devised for the purpose.

A Pocket Revolver No Bigger Than an Ordinary Watch

A REVOLVER small enough to be carried in the vest pocket and fired when concealed within the hand has been invented by a Frenchman, Turbiaux. It differs completely from anything that has hitherto been made. Moreover, it has most of the refinements of the larger weapons, such as a safety device, a ten-cartridge magazine and a device which secures a perfect registration of the cartridge chamber with the barrel.

Briefly described, the revolver consists of a steel box, circular in form, within which is the magazine, hammer, trigger and safety mechanism. Lugs on each side of the barrel serve as bearing points for the fingers of the hand. The trigger is a projecting portion which fits against the base of the thumb. Two rods connect it with the internal mechanism. When the trigger is pressed the lower rod operates the hammer, causing it to strike the cartridge; the upper rod moves the magazine. To secure perfect registration of the chamber with the barrel the trigger is provided with a rod which engages notches on the circumference of the magazine. On top of the weapon is a sliding safety-bolt, which, when pushed toward the trigger, locks it and thus prevents an accidental discharge.



The component parts of the miniature pocket revolver and the manner of using it.

To load the revolver, the safety-bolt is pushed forward, the entire cover is taken off and the weapon turned to one side, whereupon the magazine drops into the hand. The cartridges are introduced from the center, the magazine is returned to its position, the cover is replaced, and the revolver is ready to be fired. Even when the ammunition is exhausted, the little revolver will still serve as a protection, for the barrel may be used as a handle and the other part as a hammer for delivering terrfic blows.

A Doll Which Is Meant To Be Abused for the Sake of Exercise

EUGEN SANDOW, the professional strong man, has invented a physical exerciser which takes the form of a doll or figure. It is hung on the wall and battered into submission; its legs and arms are pulled at will without causing it any inconvenience.

The inventor plans to supply the child with a doll that can be turned into an unconscious exercising medium. The ordinary rag doll is easily dismembered. Mr. Sandow's doll is elastic and will thus withstand any amount of youthful pulling.

The arms and legs of the doll are made of coiled springs for exercising a child's muscles

The arms and legs of his doll consist of coiled springs with hands and feet attached. The covering fabric is securely fastened to these coils. The child can grasp either the hands or legs and pull away at them without tearing them from the body. The fabric stretches with the springs. Convenient grips are provided at the hands and feet of the doll.

An exercising harness to be fitted over the doll or figure has been provided by the inventor. The hand grips, consisting of dumbbells and elastic cords, extend just a little beyond the doll's hands and feet.

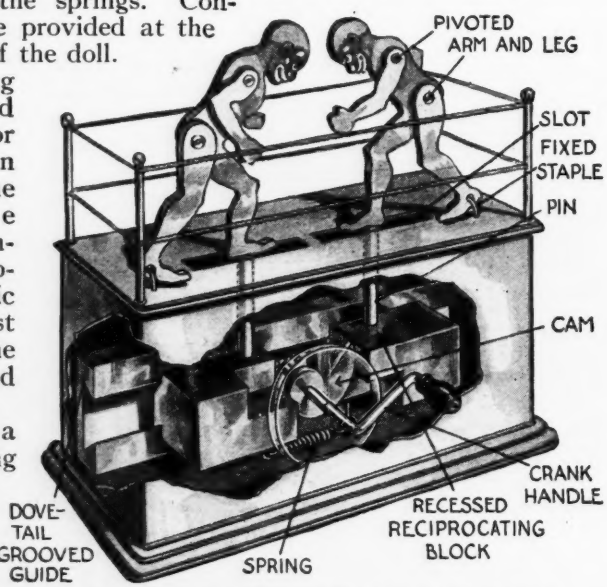
This toy is a veritable "strong doll" and will hold its own under the most violent abuse which a healthy child can inflict.

Wind a Spring and Let the Pugilists Fight It Out

WITH the season for mechanical toy novelties in full swing, the one invented by Charles E. Keffer, of Memphis, Tenn., will doubtless arouse interest. It is an animated butting match between two darky pugilists and depicts a favorite sport among the Southern negroes. The two figures are connected on a sliding-block in such a way that when the interior mechanism of the toy causes them to approach each other only their heads touch. But the force of the contact is so great that the contestants rebound briskly. They go at it again and again, however, as long as the referee, who is the youthful owner of the toy, cares to prolong the fight.

One leg of each of the figures is pivoted on the body so that in the rebound movements it seems to step backward. The arms are also pivotally attached, but they have no other part in the affray than to give a lifelike appearance to the figures. The fighting is done by the heads alone in true billy-goat style.

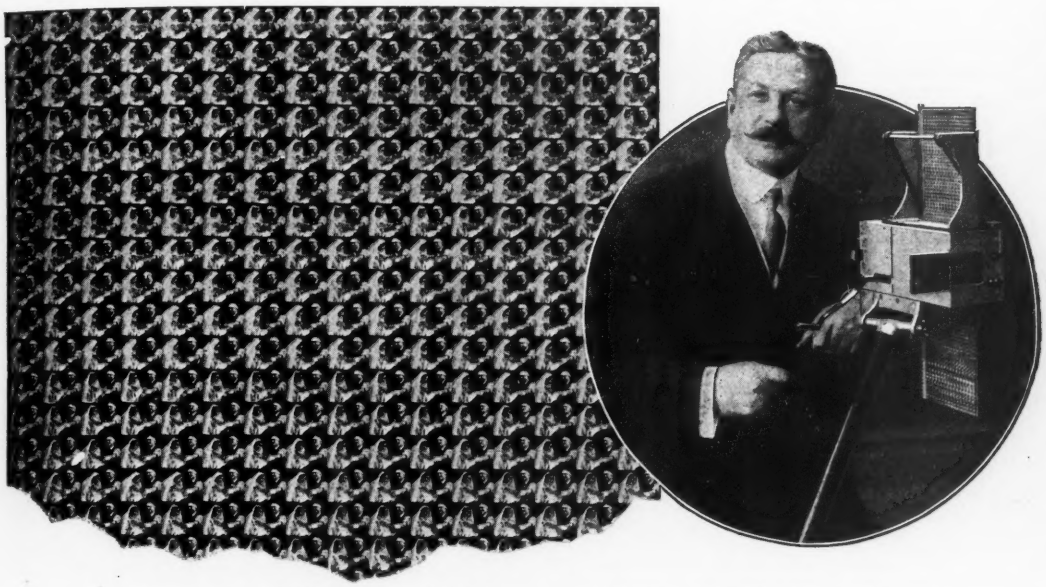
A hollow stand is provided which conceals the mechanism and serves as a platform for the fighters. Around the top of this, ropes are extended, making a regular "ring."



One foot of each of the pugilists is attached to a staple connected with the mechanism underneath

Motion-Pictures on Glass

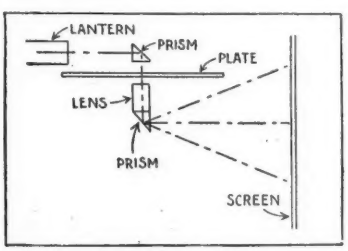
G. Bettini, the distinguished inventor, substitutes glass plates for celluloid film and thus gives the motion-picture industry a new turn



The glass plate substitute for celluloid film. The images are each one quarter of an inch square, and there are five hundred and seventy-six images on each plate. One glass plate is equivalent to about seventy-five feet of standard film. At the right is Mr. Bettini and his projector, with the plate in position for showing motion-pictures

WHEN a cheap, durable, non-inflammable substitute for the ordinary motion-picture celluloid film is found, we may expect to see motion-picture machines enter our homes and take a place beside the phonograph. So long as the cost of film is excessive, as it is at present, and so long as the film is inflammable, as it always has been and may continue to be, it will be difficult to popularize home motion-pictures.

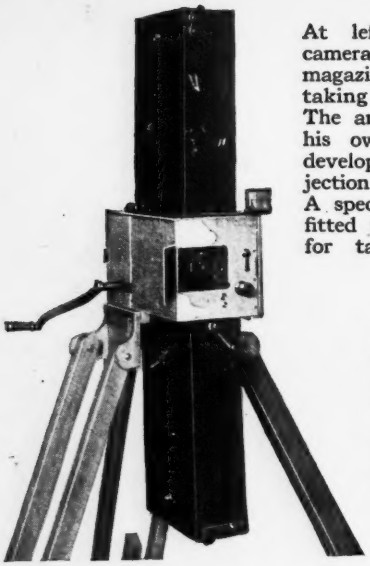
To overcome these difficulties, G. Bettini, of New York, has invented several cameras and projectors in which ordinary cheap glass plates take the place of the usual expensive film. For instance, he has evolved a motion-picture camera that utilizes glass plates in place of the usual film; a motion-picture projector for the home which uses the same glass plates; a second projector which utilizes circular non-inflammable disks; a machine which prints pictures on disks from standard film subjects, and a mechanical printer which makes square glass plate positives from standard film.



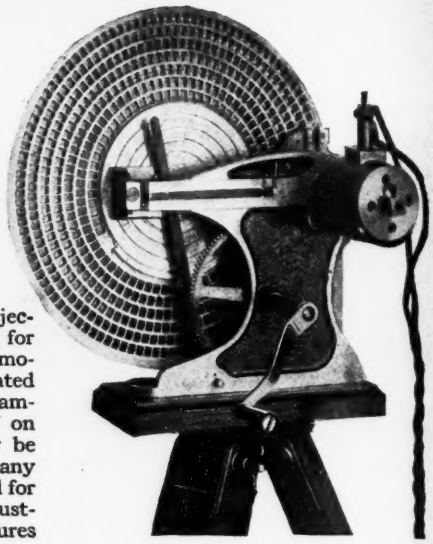
The Bettini principle of projection. The light from the lantern strikes the prism and is there bent at right angles toward the image on the plate. Passing through the plate it enters the lens to which the prism is attached, and is thrown on the screen

The glass plates which Mr. Bettini substitutes for celluloid films are the same as those used in ordinary photography, the size being approximately five by eight and a half inches. The images, arranged in vertical and horizontal rows on a plate, are each one-quarter of an inch square. There are five hundred and seventy-six images to each plate, which is equal to about seventy-five feet of standard film. The developing of the negative plates and the printing of the positives is as easy as in ordinary photography.

The Bettini principle of taking and projecting pictures is novel yet simple. The glass plate is moved downward, one row at a time, while the camera lens or the lantern lens (the lens for taking the picture



At left: The Bettini camera with plate-holding magazines in position for taking motion-pictures. The amateur may make his own negatives and develop positives for projection upon the screen. A special device can be fitted to this camera for taking photographs

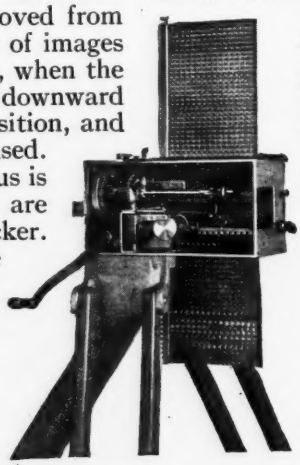


At right: The disk projector intended as a toy for children. Here the motion-pictures are printed on a flexible non-inflammable disk instead of on glass. The disk may be held stationary for any length of time required for a detailed study or adjustment of any of the pictures

and the lantern for projecting it on the screen) are moved across each succeeding row in the opposite direction. In other words, the lens or lantern is moved from right to left across the first row of images until it comes to the last square, when the glass plate is automatically fed downward to bring the second row into position, and so on until the plate has been used. The feed of the Bettini apparatus is so constant that the pictures are projected with very little flicker.

The synchronizing of the plate movement and the lens movement is so perfect that there is no "jumping" when the glass plate is shifted down from row to row. Furthermore, one plate may quickly follow another, so that the longest picture may be projected as easily as with the celluloid film.

The optical principle of the Bettini plate camera and projector—the principle on which all the patents are based—may be understood from the accompanying diagram. The objective with its prism is mounted on one side of the plate, while on the other side is a second prism on the longitudinal axis of the lantern condenser. The light from the lantern passes through a condenser, strikes a prism and is there bent at right angles toward the image on the plate. Passing through the image on the plate it enters the lens to which the prism is attached, and once more the ray is deflected at right angles so as to be thrown upon the screen.



The combined camera and projector. The plate movement and the lens movement are so perfect that there is no "jumping" when the plate is shifted down from row to row

Any image on a Bettini plate can be enlarged and printed in a few seconds. The plates may be run backwards, thus affording no end of amusement. Circular sheets of non-inflammable material may be used instead of glass plates, and circular and square plates may be made from standard films.

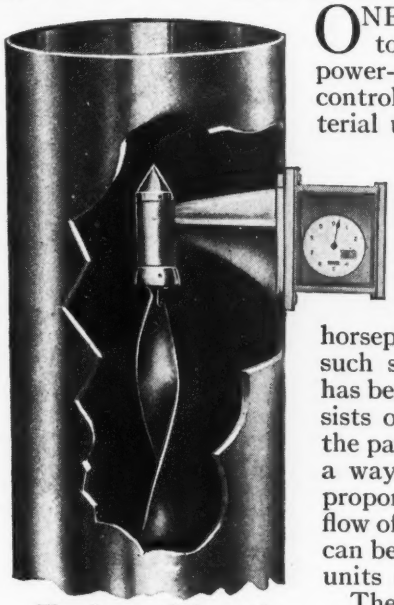
A Trip to the North Pole by Submarine

As early as 1899, Mr. Simon Lake, the inventor of the "Lake" type of submarine, proposed and planned a submarine for sailing under the ice of the Arctic waters to the North Pole. It was realized that this way of traveling would save an explorer many tedious months and would increase the assurance of his reaching his destination. But the submarine was in its early stage of development and the carrying out of the plan never got much further than a few experiments. The extensive improvements in the submarine since that time, however, have again brought this matter up for serious consideration. The submarine required need not be very much different from the *Deutschland*, it is said.

Building a Street Car Line Without Stopping Work or Cars

THERE are streets in congested districts of some of our cities where both vehicular and car traffic is so dense that even stone ballast will not prevent the "working" of the railway ties, and as a result the paving in the railway area and adjacent thereto is ruined. To avoid this, the concrete should be used under the ties.

"How can the concrete be put under the ties with the least trouble, expense and interruption to car traffic?" A novel way of doing it has been tried out and proved feasible: First, the track work is brought to the correct grade and line, using the ordinary crushed stone ballast under the ties. Then, from a small continuous mixer, placed just far enough from the rail to permit cars to pass, a thin cement grout is conveyed in chutes to the ballast. The grouting mixture is composed of one part cement and two parts sand, at about the consistency of thin cream. By the use of a flexible chute in two sections the work is carried on without the slightest interruption to car traffic. When a car comes along, the first section of the chute is thrown out of service and the second is lowered to the ballast, and so on.



The frame of the coal meter slides into a recess

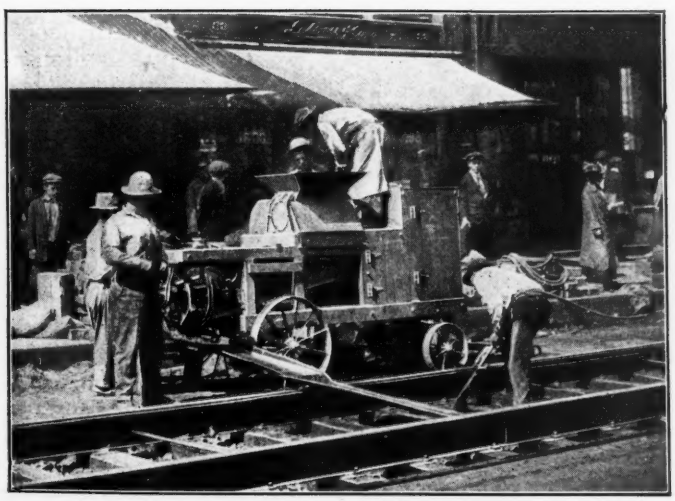
A Meter for Registering Amounts of Coal Used in Power Plants

ONE of the principal factors in the success of a power-plant is the ability to control the quantities of material used in the production of power. It is necessary to know how much water is evaporated per pound of coal and just how many pounds of coal should be used for each horsepower. In order to get such statistics, a coal meter has been invented, which consists of a recorder driven by the passing of the coal in such a way that its movement is proportional to the rate of flow of the coal. The recorder can be made to register in any units desired.

The meter was designed originally to check up the boiler room performance of a large railway plant in the hard coal fields of Pennsylvania, but it performed its task so satisfactorily that it was decided to build it for general boiler-room use. To install the meter, a rectangular slot or window is cut in the chosen pipe as shown in the illustration. The meter is then inserted "ribbon end" first, and dropped into place. No bolts, screws, rivets or fastenings of any kind are required, as the frame is made with a recess which grips the pipe firmly and prevents the meter from slipping out of place.

The face of the recorder is conveniently located on the outside of the pipe, so that it may be easily read. Thus accurate information may be obtained as to how much coal is required for a given amount of energy, and statistics are found that help in estimating the upkeep of the plant.

Other advantages of this type of coal meter are the durability of its construction and the little attention which it requires to keep it in perfect working condition. There is nothing about it to get out of order.



A flexible chute in two sections is used so that traffic is not interrupted while the cement mixture is being deposited

At left: The three-wheeled vehicle with inclined screen, bucket conveyor and mechanical feeder

Below: The machine in operation. The feeder is suspended on a cable and adjusts itself to the pile

Filling Twenty Coal Bags by Electricity in Four Minutes

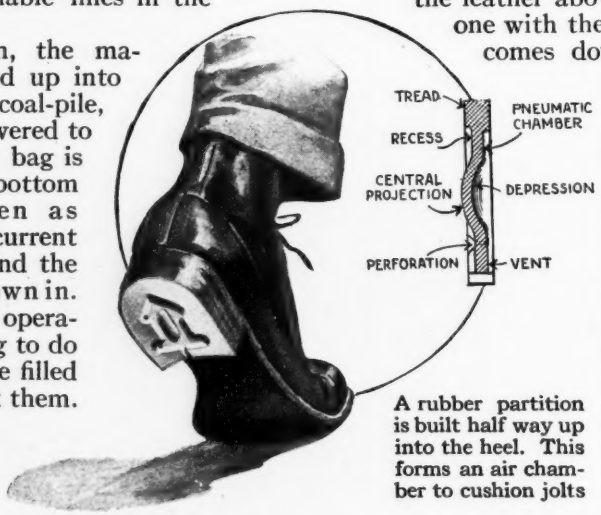
ONE man and the coal-bagging machine shown in the accompanying illustrations can fill and stack twenty bags in four minutes. In many cities with a large number of private residences without suitable driveways coal is delivered in bags. In such cases bagging the coal by hand has always been slow and expensive. To eliminate this cost the machine shown herewith was designed.

It consists of a small three-wheeled vehicle having an inclined screen, small bucket-conveyor and a mechanical feeder which automatically pushes the coal to the bottom of the elevator. The machine is chain-driven from a small electric motor beneath the conveyor, receiving its current from the available lines in the yard.

In operation, the machine is backed up into the base of the coal-pile, the feeder is lowered to the surface, a bag is placed on the bottom of the screen as shown, the current is turned on and the clutch is thrown in. After this the operator has nothing to do but remove the filled bags and stack them. The feeder is suspended on counter-weighted cables so that it adjusts itself to the surface of the pile. It is provided with a metal hood to prevent clogging in case of a pile slide. Four removable screens are furnished.

Put Pneumatic Tires on Your Hiking Shoes

TAKING his inspiration from automobile tires, and going the ordinary rubber heel one better, Mr. Oscar Mussinan, of New York city, has invented a pneumatic tire for his own shoes. The "tire" differs very decidedly from the ordinary heel in that a partition of rubber is built in it half way up its thickness. The partition thus forms an air chamber with the bottom of the leather above it, and still another one with the ground when the heel comes down upon it. Each of these two chambers is connected with the outside air by a small opening. When the heel strikes the ground, the air in the chambers becomes slightly compressed causing the jolt of the walking to be very greatly cushioned in a manner very much similar to that in which the automobile tire cushions the jolts of riding. To prevent the air from becoming too suddenly compressed and so putting the bottom of the heel out of shape, the air is allowed to escape slowly through the openings during these compressions.



A rubber partition is built half way up into the heel. This forms an air chamber to cushion jolts

Strap Your Purse to Your Thumb. No One Can Steal It Then

PSYCHOLOGISTS and criminologists have asserted that the carelessness with which people handle their purses and expose their valuables on the street or in public places is responsible for a great majority of thefts. The temptation to steal is thrust under the very noses of those who are not inclined to resist.

The wearer of the purse in the accompanying illustration need not face such an accusation, for it is provided with a strap which holds it securely and leaves no opportunity open for a thief or pickpocket to make off with it. Not only does it embrace the hand, but the strap also passes over the thumb, so that the purse can not slip from the hand even when the fingers are relaxed. By this arrangement the weight of the purse rests on the palm, just as though the purse were held in the hand in the ordinary manner. Yet the hand and fingers are perfectly free to be used for other purposes.

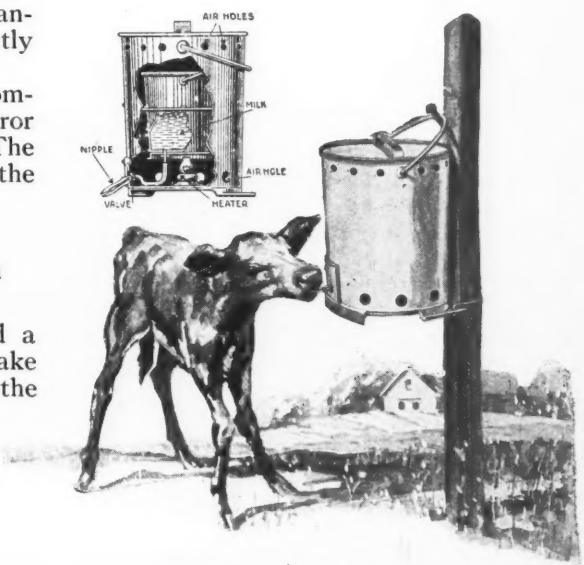
The strap passes around the hand, fastening over the thumb

The purse itself is two-fold and has compartments for bills, cards, change, a mirror and the inevitable powder and puff. The handkerchief may be tucked under the thumb-strap, for safe-keeping.

Nursing Orphaned Animals with a Tin-Can Mother

THE old saying that you can lead a horse to water but you can't make him drink isn't any more truthful than the statement that you can lead a hungry colt or a calf to a pail of warm milk, but you can't make it drink. Not because the youngsters are stubborn, however. They are willing enough to drink the milk, but they don't know how. That is one reason why inventors have been busy devising some sort of make-believe nipple to attach to the milk pail—a nipple that may not work as efficiently as the hungry calf might wish, but which will answer the purpose nevertheless.

It looks as though Charles E. Johnson, of Fond Du Lac, Wisconsin, had come nearest to the real nipple with the suckling device illustrated. The automatic nipple he has constructed is attached to an ordinary milk-pail. In operating it the young animal grips the forward end of the nipple in his mouth and closes the front sections upon each other, thus releasing a tube at the rear end of the nipple to permit the milk or water to flow freely. Whenever pressure is released on the forward ends of the sections of the nipple the supply is checked automatically by the action of a bow-spring. The liquid flows out of the nipple only during the time the animal is suckling or pulling it. An oil heater is placed under the milk container inside the pail, as shown at the upper left of the picture, to keep the milk warm.

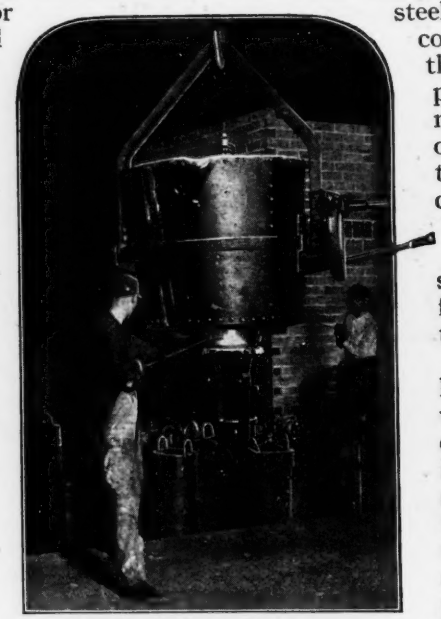


Her mother is a tin-can hung from a nail in a post

Electric Steel from Electric Furnaces

We were forced by the exigencies of war to develop our own crucible-steel industry. Now we lead the world

ELECTRIC steel is now a commercial success, and the United States leads the world in its production. Until it became possible to melt and refine steel by the use of electricity as a source of heat, instead of gas or oil, nearly all steel was made either in crucibles or small pots, or in large coal or oil furnaces. Large furnaces, known as open-hearth, today still make the majority of the steel produced in the world, but it is the electric steel furnace which now makes the best and purest steel, rapidly displacing that made in small crucibles, hitherto the best for tools, razors, etc.



Tapping molten metal from an electric furnace. Steel flows from it like water from a tub

The unusual qualities possessed by electric steel are not bestowed on it by the electricity itself. This should be clearly understood. The conditions are responsible rather than the agent itself. In other furnaces where oil or gas and air are the heat-producing mediums, there is more or less contamination from impurities, such as sulphur, as well as from the oxygen of the air itself, too much of which is often harmful to steel. But in the furnace, electricity is an even and very intense source of heat; the conditions can be so regulated that the air or oxygen has but little effect on the steel. Practically no contamination is possible. Also the temperature is so high that more refining is attainable than in any other furnace. In other words, certain chemical reactions can take place so as to remove objectionable elements—an impossibility in other steel-making furnaces.

One of the qualities that distinguishes electric steel is its greater purity. Hence it is stronger than other steels. Compare it with any steel made by any other process and of the same composition, and the electric steel will show greater strength. Many steels are susceptible to change from frequent shocks. Some give out and break down before others under such conditions. Again, electric steel is superior to others in this respect and is now used in many places where shocks must be withstood, as for automobile axles, springs, etc. Electric steel is also very uniform in composition and is denser than other steel—both important qualities. Steel made by the usual and older processes also contains varying amounts of certain gases included in them, strange as this may seem. Electric steel, however, is very free from these objectionable constituents.

Europe and particularly Germany had always led in the use of electric furnaces for making steel until the war started. Development in this country had been very slow partly because electricity was high and partly because there was not a large demand for such a high grade steel. The actual need was supplied by importations from Europe. As the war progressed and electric steel could not be imported when needed we were forced to develop our own electric steel industry. In addition plumbago crucibles, with which crucible steels, then the high grade steel, were made, advanced so in price and became so expensive and hard to get that crucible steel makers were driven to the electric furnace. Today in this country all but two or three crucible steel castings makers are now using electric furnaces instead of crucibles and would not change back to the old process if they could. Their product is better and more easily made. Tons are made at a time where formerly it took over twenty crucibles to make one ton.

The expansion in this branch of the steel industry in the last six years in the world and in this country is astonishing.

At Last! Electric Steel Is Here

The electricity after passing through a system of connections and transformers enters the furnace through the three large carbon sticks or electrodes which can be seen issuing through the roof. This particular view shows a six-ton furnace. Into it, when hot, either cold scrap iron or steel or sometimes molten pig iron is put and the electricity turned on. In three or four hours the process is completed and the steel is ready to pour. Tons of electric steel are now made in a single furnace where formerly it took over twenty crucibles and much time to make one ton

Imitating an Imitation

Japanese craftsmen have for centuries made fortunes by cleverly charring sugi wood to imitate driftwood. Americans are now applying the process to our own cypress

By Robert H. Moulton

UNDOUBTEDLY a good many of us own specimens of so-called "Japanese driftwood," which is not driftwood at all, but clever imitations made from the sugi tree. For many centuries Japanese craftsmen have plied a thrifty trade in this wood. In the beginning they gathered genuine driftwood from the sea and turned it to uses of beauty without treating it in any way. Its embossed-like surface was due to natural agents. The chemical action of the salt of the sea and the long-continued churling of the waves ate out and carried away the softer parts of the wood and left the harder grain.

The process consists simply in charring the wood with a gasoline torch, scraping it afterward with a steel wire brush and polishing it by rubbing

However, the supply of driftwood was limited, and its evolution from the fresh wood by the action of the sun and the sea, covered a long period of time. The crafty Orientals then conceived the idea of producing artificial driftwood. This was accomplished by charring the fresh wood with fire and then by rubbing it with rice-straw. The artificial driftwood had all the appearance of the genuine, and it was long before the imposition was discovered. Finally, however, a noted scholar and traveler, the late John S. Bradstreet of Minneapolis, discovered the secret. He then set about to find an American wood capable of taking the sugi finish. After many experiments Mr. Bradstreet discovered that cypress was practically the only one that would stand up under the sugi process.

The process of treating cypress to secure the sugi finish is so simple that it can be carried out by any one. The only tools necessary are a gasoline torch of the kind used by plumbersor painters, an ordinary steel-wire brush, and a small scrubbing-brush. The torch should have a large and exceedingly hot blue flame, since success in securing the desired effects depends largely upon the speed with which the burning or charring of the wood is done. Cypress wood, like the wood of the sugi, is close-grained, and, when cut into flat sawed boards its appearance is very beautiful. The spring growth is much harder than the summer growth, and when heat is applied it merely discolors the harder grain while the softer summer wood is completely charred. All the charred portion is then brushed out by the wire brush. This leaves the wood entirely covered with a fine powder which must be removed with the small scrubbing-brush. Cloth should never be used for this purpose as it has the effect of rubbing the powder into the wood.

Charring the wood properly is perhaps the most difficult part of the work, although it is also important that the rubbing be done evenly so that the tone will become uniform. The more the soft grain is rubbed out, the lighter will the general tone become.

FOR PRACTICAL WORKERS

A Pliable Metal Screen Fabric as a Substitute for Glass

A FABRIC which has the strength and lasting qualities of metal and which may be bent to any shape and used as a substitute for glass in windshields, as screens for lamps and lanterns, and for many ornamental purposes may be easily prepared from ordinary mosquito netting and glue, colored according to taste and to the use to which it is to be put.

Take 2 oz. of gelatine or glue and let it stand for one-half hour in 32 oz. of water, then place the vessel containing the glue in a saucepan of boiling hot water and let it remain until the glue is melted. Do not try to hasten the melting by setting the vessel over the flame, as this will spoil the setting properties of the glue. Strain the liquid through wet cheesecloth into a heated tray. Have at hand several pieces of mosquito netting, 6 or 8 in. wide, and cut across the entire width of the roll, which is usually 30 in. wide. If this netting is previously coated with nickel or zinc by electro-deposition it will make a stronger fabric. Grip the strip at the ends and pass it slowly through the hot glue, so that the formation of air spaces may be prevented. Suspend the strip for one hour or until thoroughly dried.

Having thus prepared several of these strips, take each one singly, bend it into U-shape and pass it backward and forward through a solution composed of 2 oz. of 40 per cent formaldehyde and 32 oz. of clear water. Suspend to dry without washing. This will set the glue so thoroughly that it will be insoluble even in boiling water. When the strips are dry they may be dyed any color with analine dyes. Common red ink will dye the fabric a brilliant red for the photographic darkroom and blue ink will furnish just the right shade for developing paper prints.

After the netting has been prepared in this way it is non-inflammable

This fabric is light, pliable, fireproof and waterproof. It is semi-transparent and can be rolled up and packed away, and will lend itself to any number of uses.

Owing to the pliability and texture of the material it can be readily cut into any desired shape or size to fill in a window sash. Large trays may be used and relatively large pieces of the netting prepared in a like manner, to be used for porch screens or sun parlors.

Magnetic Base for a Machinist's Electric Light

ELECTRIC light has become the one illuminant for the machine-shop, because it can be handled readily and moved to the best location for throwing the rays on the work. Hooks, arms and adjusters are many for this purpose, but the magnetic base seems to outshadow them all. It consists of a coil with a soft iron core which is connected in series with the socket. When the current is turned on in the lamp its base can be set in any position on a machine-tool and the lamp will be held securely in that position by magnetic attraction.—JESSE J. NACHMAN.

The current in the coil makes the base magnetic

The Protection and Care of Shop Belts

THE best man in the plant should have special charge of the belts. He should be a man capable of using his imagination as to what a belt has to undergo on a drive. The belt swings around the pulley on the driving machine, and the strain on it rises from almost nothing in a tenth of a second to a pull of several hundred pounds as the belt leaves the drive-pulley on its trip to the shaft-pulley.

Suppose the belt is driving a machine with a jerky power driver, not balanced by a flywheel, and while the belt is tightly stretched under this pull it is violently jerked and tugged as well. This puts a big strain on the belt at the moment when it is least able to stand it. The belt for such a drive should be broad and thin, if it runs on a small pulley.

When the belt reaches the shaft-pulley the strain drops to almost nothing, and it runs back slack to the machine-pulley. But, if this machine is not running smoothly, the belt is alternately let down and tightened up on the slack side, and each tightening makes a sharp, sudden strain which tends more and more to tear the belt to pieces the slacker the belt is, acting just like a whip in its sudden tautening. One can readily see how this destroys the belt at the fasteners and joints.

The size of pulleys makes a difference in favor of belt service. The larger they are the less the strain and the better they hug the additional length of pulley surface. If a belt on 5-in. pulleys breaks down frequently, the pull on the same belt running over 10-in. pulleys will be just one-half, and the pulley adhesion just twice as great. Of course, the speed of the belt will be doubled. Furthermore, a double belt may be used on the enlarged pulleys to convey still more power, if necessary. Such a double belt would quickly wear out on the small pulleys.

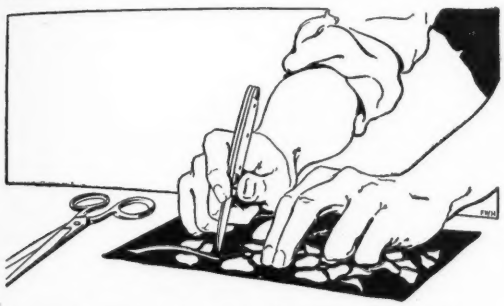
Carrying Two Large Cans of Water with Little Effort

IN a very old but flourishing mining town in California, a most interesting labor-saving device was seen recently. It made a comparatively easy task of carrying two 5 gal. kerosene-cans full of water. The device consisted of a light wood frame made of slats or thin boards, 3 ft. square, and braced in the corners. This frame separated the two containers from the carrier as shown. Practically no strength is required in carrying the load, since the tendency is for buckets or cans to come together instead of exerting a vertical strain.—AUSTIN ARMER.

The frame keeps the containers away from the carrier and lightens the work considerably

Cutting Stencils from a Discarded Photographic Film

PHOTOGRAPHIC films, which are usually destroyed when they are spoiled, make excellent material for stencils. Pictures or other designs to be stenciled may be pasted on the film and the outline cut out with a sharp knife. It is necessary to



The stencil is cut with the dull side of the film down, to prevent it from slipping

use care in selecting a design suitable for stencil work. For large designs it is necessary to leave binding strips to secure a satisfactory stencil. The films are used with the dull side down to prevent their slipping. A large variety of designs may be made from pictures clipped from publications of various kinds.

Ironing a Four-in-Hand Tie Without Making Glossy Streaks

IT is not an impossible task to wash a four-in-hand tie. The difficulty comes in ironing it in such a way that its original shape will be restored. To do this it is necessary to proceed carefully. Start by placing the wide end of the tie upon the board with the seam up, then thrust in the finger and take hold of the lining. Grasp the silk cover in the other hand and pull it back from over the lining for about half of its length. Then with a hot iron run over the lining to straighten it out. Cut a piece of stiff cardboard to fit into the wide end of the tie and long enough to reach to the narrow band. Slip this in between the lining and the seam side of the outer layer. Then dampen a clean cloth, lay it over the tie and iron in the usual way.

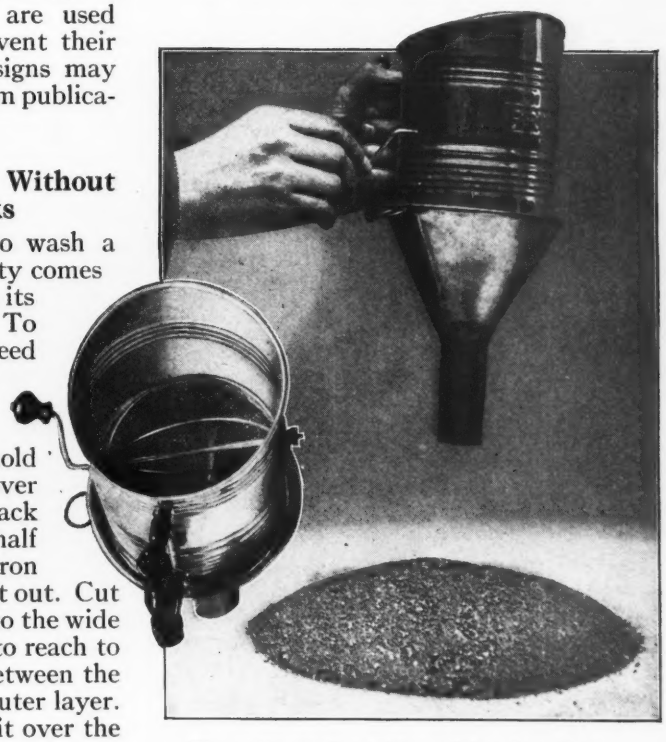
The cardboard form will prevent the pressure of the iron from causing a glossy mark to appear on the silk front opposite the seam. When through, put the form aside for another time.—EMILE PARENT.

Pulverizing the Powder in Fire Extinguisher Tubes

WHEN the powder in fire extinguisher tubes becomes caked, the inspector usually empties the contents of the tube on a paper and re-pulverizes it with a crusher. It is more convenient to use a sifter like the one illustrated and screen the extinguisher powder through it.

Take an ordinary one-quart flour sifter and a funnel of sufficient size to fit over the lower end of the sifter. Remove the spout of the funnel so that an opening of at least ¾ in. is formed. Make a cylinder of tin, slightly tapered toward one end, about 3 in. long and of sufficient diameter to fit snugly into the mouth of the dry powder tube. Make ⅜-in. slits, about ⅜ in. apart, around the larger end of the cylinder and press it over the lower end of the funnel so that the flanges, formed by cutting, bend outward to conform with the shape of the funnel. Solder firmly in this position.

The powder should be emptied from one of the tubes into a convenient receptacle.



The ordinary flour sifter with a funnel attachment for pulverizing caked powder

Then place the end of the funnel into the empty tube and sift the powder from a full tube into the empty one. Fill the last tube with the powder from the first one.

Modern Conveniences on the Farm

Inexpensive machinery for a lighting and water system.

By H. B. Roth

TO have city comforts and conveniences in the farm home, it is necessary to have some kind of power. If there is a stream of any size, electricity is the cheapest power obtainable. Lacking this, a gasoline engine is the best possible solution of the problem.

On a recently purchased farm in southern Michigan, the owner has made it his first duty to supply those comforts which are luxuries to many farmers, but absolute necessities to the family which has formerly lived in a large city. An adequate water supply being the first consideration, a 6-in. well was driven through hard-pan and blue clay to a depth of 90 ft. Good water was struck 20 ft. below the surface. However, the deeper well yields a continual flow of cool water of a superior quality. To convey this to all the buildings, an automatic pump which works by air pressure was placed within the 6-in. pipe. A large air-compressor tank run by the gasoline engine stands in the house sheltering the well. There is no storage tank for water. A faucet opened anywhere starts the action of the pump, and fresh water directly from the well is immediately obtainable.

The same engine which pumps air into the compressor-tank runs the dynamo which charges a set of storage batteries furnishing electricity for the entire farm. By the same power corn is shelled and ground, alfalfa turned into meal, and the grindstone turned for the busy man. Even the exhaust from the engine is utilized. A discarded water tank is set on end beside the engine. The exhaust pipe is run into this tank, which radiates enough heat to raise the temperature above freezing. The extended pipe, connected with a rectangular pipe-frame resting on the floor of the watering trough outside, prevents the water from freezing in severe weather.

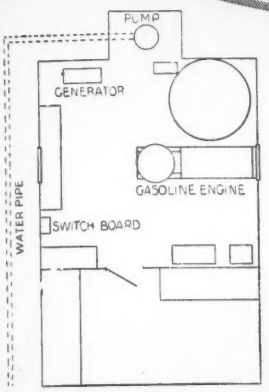
The water is piped to the house, supplying two bath-rooms, kitchen and laundry. There is also a hydrant furnishing fresh water in the pig-house which is also supplied with a large feed-cooker. The overflow from the well is piped to the hen-house where the water trickles into troughs made of galvanized eave drains that are securely fastened to the side of the house at the proper height. At the farther end of the 56-ft. poultry house, the water empties into a pipe which carries it 100 ft. or more to a trough in the colony yard, supplying another flock of chickens. The troughs are brushed out daily, and the flow of water is steady enough to insure coolness and purity at all times. The water may be shut off within the engine-house on cold nights, and any coating of ice in the trough is quickly melted with a kettleful of boiling water.

For baths, kitchen and laundry work, and the scrupulous care of milk utensils, a constant supply of hot water in the house is of great importance. The hot-water tank is connected with the hot-air furnace and laundry stove. However, it was not always convenient to keep a fire in the laundry stove, especially in hot weather. After much consideration, a blue-flame oil heater was installed, and that has given perfect satisfaction during the past year. It is used in connection with the laundry stove on wash-days, and alone at other times. After the water is hot, which is in a very short time, two of the three fires may be extinguished, leaving one burner lighted to insure hot water at all times. If the water is entirely cold, the three burners lighted will heat enough water for a bath in 20 minutes. The heater is simple in construction, easily cared for, and much cheaper and more convenient to run than a coal stove.

Electricity lights the engine-house, poultry house, stable, barnyard and residence. An electric iron is considered the greatest labor-saving device in the house. There are outlets in the kitchen where electric stoves may be attached, and a vacuum cleaner may be run on the same current. It is the owner's intention to install an electric motor in the basement for the purpose of running the washer and cream-separator, as the engine house is too far distant from the residence to make use of the gasoline engine for these purposes.

It is possible to have all the conveniences and comforts in the farm home at practically the same cost as in the city establish-

Running a Farm with Gasoline and Electricity

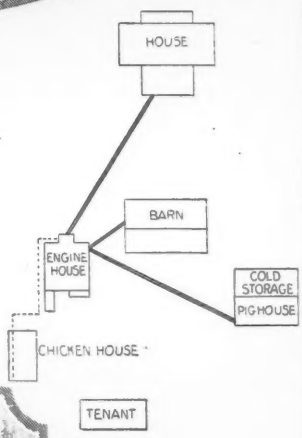


Above: The country residence supplied with light and water for all purposes from the farm power plant

Left: Power house plan showing location of engine, pump, switch board, generator and water pipe from the pump

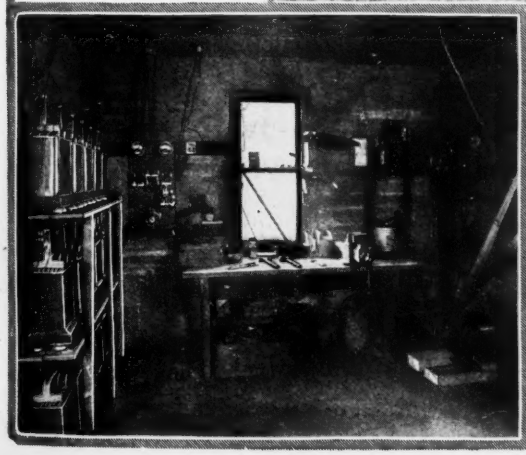
Right: Ground plan showing location of the residence, engine house and buildings supplied with light and water

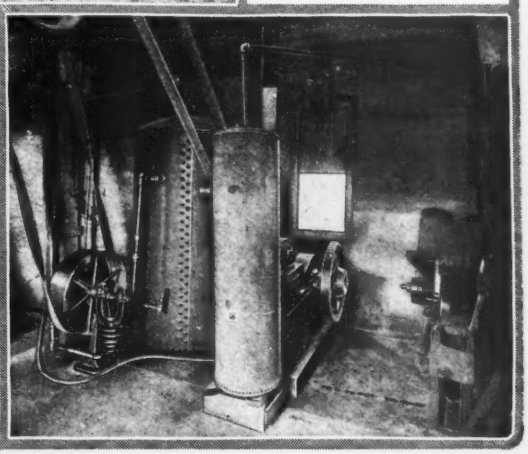
Below: Outside of engine house which is an extension of a shed covering the water tank and occupies little space



Below: The dynamo of the plant where the storage battery and switch board are found

Below: The engine side of the power house in which an air compressor and tank are located



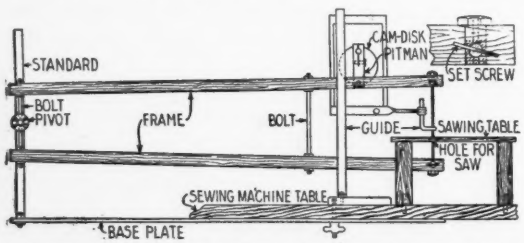


ment. The first cost for installing the machinery is the greatest expense. The up-keep amounts to very little, especially if the owner is fortunate enough to secure the services of an intelligent man-of-all-work, one who is handy with tools and can make ordinary repairs when necessary. On this particular farm the handy-man was the inventor of the tank heater for the engine-house and watering trough. He also fitted up the family surrey with electric lights, fitting the tiny bulbs into the lamp-wick sockets, and connecting them with dry cells placed under the front seat. A home-made switch turns on both lights at once.

Foot-Power Jig-Saw Made from a Sewing Machine

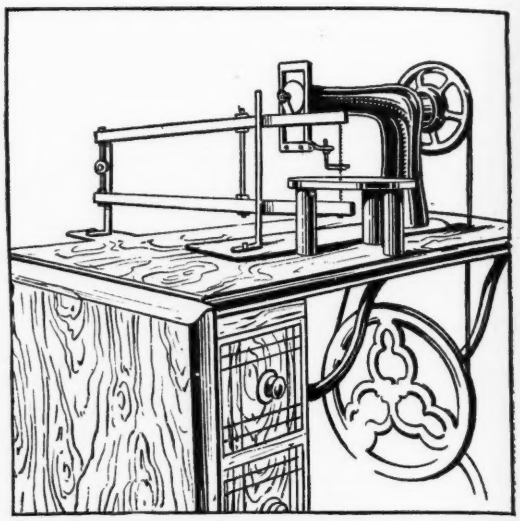
AN old sewing machine that had outlived its usefulness in that capacity and was to be discarded made the groundwork for the jig-saw as shown in the illustration. The shuttle, the mechanism driving the needle-holder and the step were removed. Only the hand-wheel together with its shaft and cam-disk at the end were used.

The frame of the jig-saw consists of two arms 21 in. long, ⅝ in. wide and ½ in. thick. Each piece is drilled through the width, making three holes, one 3/16 in. in diameter ½ in. from the rear end, one 15 in. from the same end, and one ¼ in. hole ½ in. from the opposite end or front end of the frame. A 1/16-in. hole is made in the side of the upper piece 4½ in. back from the front end. The two pieces are held together at the rear end and 6 in. from the front end with bolts having long threads on each end and a



The frame of the jig-saw for attaching to the sewing-machine table and head for small jobs

nut on both sides of the stick. The rear end bolt is made up of two pieces, each 2¼ in. long and 3/16 in. in diameter with threads on both ends, 1¼ in. in length on one end and ¼ in. on the other. The shorter threaded end is turned into a hole tapped into the side of a round piece of iron that is ⅝ in. long and ¾ in. in diameter. The piece is also drilled centrally with its length for a ¼-in. bolt. This bolt runs through a standard 10½ in. long, ⅜ in. wide and 3/16 in. thick that is fastened



The frame on the sewing machine where it is driven by a crank attached to the head shaft

to the base plate of metal running beneath the sewing-machine top. This latter plate is 21 in. long, 1½ in. wide and ¼ in. thick. This is fastened to the top with a thumb-screw turned into a tapped hole in the metal sewing-machine base.

In the outer ends of the saw-arms are placed screws which are centrally drilled for the saw-blade end and a set screw affixed to clamp the saw in place. The sawing table is made up like a three-legged stool, the top being a round disk 6 in. in diameter and ¼ in. thick. To prevent the saw blade from lifting the board up at each stroke a guide is used above it. The guide consists of a 3/16-in. rod bent L-shaped, one end being flattened and the other having a long thread cut in it. A bar fastened to the lower part of the square frame on the sewing-machine head makes a support for this guide.

A short pitman is used on the cam-disk to drive the frame. The shaft and cam-disk are, of course, driven by the usual treadle, wheel and belt drive that was originally used on the sewing machine.

While this arrangement does not give any great swing in the opening under the sewing-machine head it can be used on a great many pieces for building up small work.—E. M. Davis.

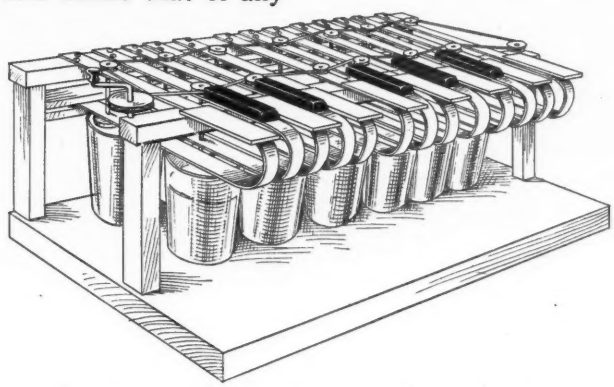
How to Make Mechanical Crystal Chimes

Tones produced by rubbing partially filled drinking glasses with revolving wheels

By J. S. Zerbe

EVERY one is familiar with the musical tones produced by gently rubbing the fingers over the edge of a tumbler, the necessary preparation for producing the sound being moisture. The vibratory action is greatly augmented by acidulating the water, using the juice of a lemon, citric acid or vinegar.

The illustration shows a device which is easily made, wherein a dozen or more glasses can be used, the proper tone and pitch of each being determined by the amount of water which is carried in the glass. The music from such a group is exceedingly sweet and unlike that of any other instrument. The tones are considerably improved by mounting the mechanism on a box, which thus serves as a sounding board.



Keys representing the natural scale are used and clear musical tones are produced from the glasses

As herein shown the base is simply a board, 16 in. long, and 8 in. wide, with a post at the rear corner of each end on which is mounted a longitudinal bar, the top being 6 in. from the base. Parallel bars are placed 2 in. below the first one. These are slightly separated from each other, to receive between them the rear ends of the lower members of U-shaped key-bars.

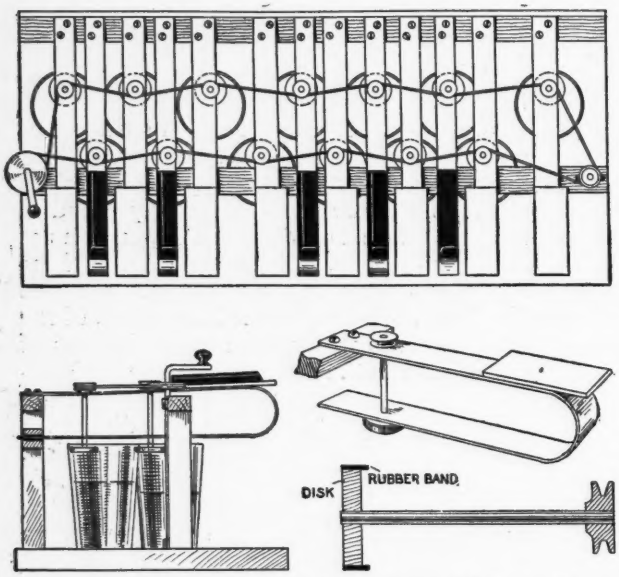
The key-bars are made of soft steel strips, each 14 in. long, ½ in. wide and 1/16 in. thick. These are bent to assume a U-form, the upper and the lower members being parallel with each other. The rear end of the upper member is secured to the top of the longitudinal bar by means of two screws, while the lower member rests between the two parallel bars mentioned. On the forward ends of these key-bars are mounted the keys for the musical scale, the natural scale being preferable, which keys are spaced equidistant from each other. The keys representing C sharp, D sharp, F sharp, G sharp and A sharp are placed between the keys thus indicated.

Before the key-bars are put into position two ⅛-in. holes are bored through each member, one hole 2½ in. from their rear ends, and the other 5 in. distant. These holes serve as bearings for spindles, each of which is 2 in. long. On the upper end of each spindle is a grooved pulley, and on the lower end a disk, a little less than half the diameter of the top of a glass. On this disk is strapped a thick rubber band, of the kind which is wider than the thickness of the disk, so as to form a receptacle for holding water on top of the disk when it is in position. An endless belt passes along the two trains of pulleys, starting from a power pulley which is operated by a crank. An idler pulley at the opposite end, which is capable of being moved a limited distance, serves as a tightener for the belt by which adjustments are made.

The tumblers used are of thin white glass, and these are arranged below the spindles so that a disk is within each glass, but fully ⅛ in. from the rim at the rear side of the glass. In that position a downward pressure on the key will cause the lower member of the key-bar to move to the rear, through its bearing, and thus bring the rotating rubber-tired disk against the inner edge of the glass. In mounting the glasses on the board they can be securely held by a coating of thick gum tragacanth.

Water is put into the various glasses, and more or less added until the proper musical pitches are obtained. A mark is then placed in the side of each glass so that there will be no trouble in refilling them to get the correct tones. The disks may be turned by a motor or by an assistant.

The flexible character of the key-bars permits the operator to exert a greater or less pressure without materially affecting the movement of the rotating disks, and thereby enables him to accent the musical strains. The water used should be well



The revolving rubber disks may be turned by a motor or by an assistant to the person operating the keys

acidulated and a quantity placed in the cup-shaped retainers on the upper sides of the disks. More or less of this water will flow over the rubber bands during their turning movement and thus constantly provide sufficient moisture to produce the best results.

Electricity Used to Start a Balky Horse

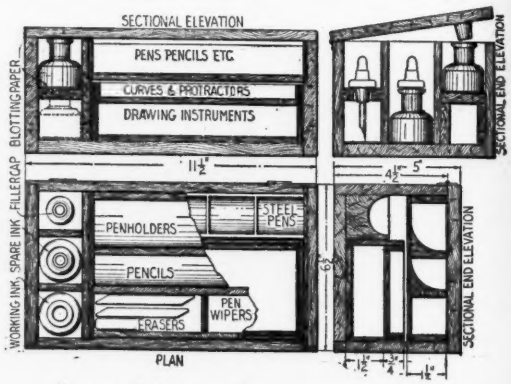
A PENNSYLVANIA farmer who owns a valuable horse, cured it of the habit of balking by using electricity. He purchased a small storage battery, connected it with wires to the bit and crupper and placed the battery in the cart to which the horse was attached. When the horse refused to move and stood with all four feet braced, the owner touched the button connecting the lines with the battery. The horse received a slight shock and he snorted and jumped and began to move off at a lively pace. Every day for a week he was given the same treatment. As a result the balking habit was completely broken up. Upon investigation the local Humane Society decided that a little electricity is better than a whip.—MRS. C. A. WOLFE.

Handily Arranged Case for Holding Drawing Materials

THE drawing shows the construction of a convenient case to hold drawing materials used by the draughtsman, pen and ink artist or student. The outside dimensions are 5 in. high by 6½ in. wide by 11½ in. long. A hinged cover ½ in. thick, fastening with a hook or lock is provided. One end is partitioned off to hold ink bottles. The partition near the front has a raised bottom so that the ink bottle in use will rest with its top almost flush with the top of case. This bottle should be wedged in. Instead of using the regular filler-cap to close the bottle when not in use, the bottle is stoppered by means of a cork screwed to the hinged top of the case, as shown.

The cap is kept in the back partition, a block with a hole in its center being provided to hold the point of the quill from the bottom of the case. Thus as soon as the lid is raised the ink is ready for use. While being used the filler cap may be kept in the bottle. Space is left in the middle partition for a spare bottle of ink with its cap. These bottles should rest on pieces of blotting paper to absorb any ink which may be spilled. Blotting paper is also placed in the bottom of the partition where the filler cap is kept.

A shallow wooden tray is set into the upper portion of the main part of the case,



A case with convenient compartments for all tools used in ordinary drawing work

and is divided into four parts. Two are full length, to hold penholders and drawing pencils, while the remaining one is divided in two, one part holding erasers and the

other penwipers. The pen and pencil spaces have curved bottoms to facilitate the removal of the pencils and holders.

One side of the bottom part of the case contains a long tray with rounded bottom, partitioned off to hold different kinds of steel and other pens. The remaining space is taken up by two telescoping trays, the upper one being shallow and holding French curves, protractors, etc., while the bottom tray holds the drawing instruments. When in use all these trays may be taken out and set at any convenient point. If the case is to be kept at the right side of the drawing-board, which is the usual place, care must be taken that the ink-bottle partition is located at the left side of the box, as shown, as the ink will be much easier to reach.—H. H. PARKER.

A Mixture for Removing Paint From Wood

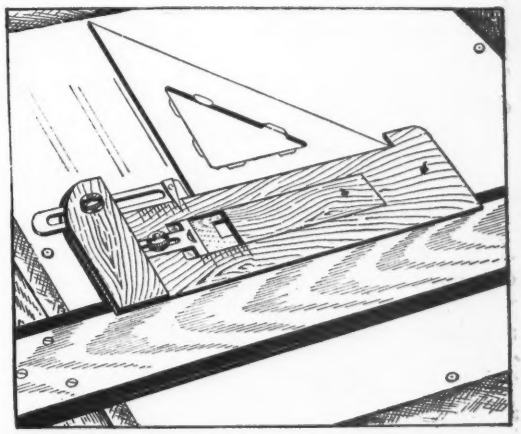
SOME very satisfactory paint removers can be made by mixing up proportions of such substances as acetone, amyl alcohol, carbon bisulphide and ethane tetrachloride. Any one of these liquids will suffice and may be applied with a brush or made up in paste form and applied with a pad. A good preparation may be had by mixing together ½ lb. of potassium hydroxide, 1 pt. of acetone, ½ pt. each of methylated spirit, oil of turpentine, petroleum spirit and 5 oz. castor oil. A thin coat of this is spread over the paint surface and a few minutes later another application is made. This will soften the paint so that it can be removed with a scraper or spatula.

Cleaning the Oil-Pump Screen on an Automobile Engine

FAULTY lubrication of an automobile engine may be traced to the clogging of the pump-screen by particles of dust and dirt from the incoming oil, with the result that a portion of the screen is defective and instead of allowing the oil to pass freely into the pump-chamber it serves as a barrier to its passage. For this reason the bearings receive an insufficient amount of oil and they become hot, causing the engine to lose power. It is necessary to remove the pump-screen and wash it thoroughly. Experience will teach the motorist that if this is done frequently, less trouble will result from improper lubrication.—ADOLPH KLEIN.

To Make a Triangle Gage for a Cross-Section Liner

THE gaging of lines accurately for cross section work on a drawing requires some mechanical device. Lines cannot be drawn evenly spaced by dividing with a scale. The illustrations show the parts used in the construction of a cross-section

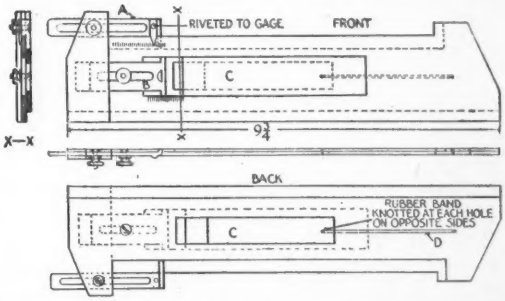


Manner of placing the triangle and gage on the drawing board against the T-square

liner which is used in connection with a T-square and triangle on a drawing board.

An old wood T-square or triangle and gages cut from brass or aluminum (preferably aluminum) are the necessary parts. The binding posts taken from discarded dry battery cells will make good thumb nuts. Cut all the slides to fit the grooves as true as possible to avoid any side motion. Make all the parts according to the details in the illustration and glue them together as designated.

To operate the liner place it on the edge



The parts made of an old T-square with metal gages of aluminum. These are glued together

of the T-square as shown in the illustration. Adjust the gage *A* to the desired spacing distance on the scale and in the same manner adjust the gage *B* for a variable distance. Start by placing the triangle tight

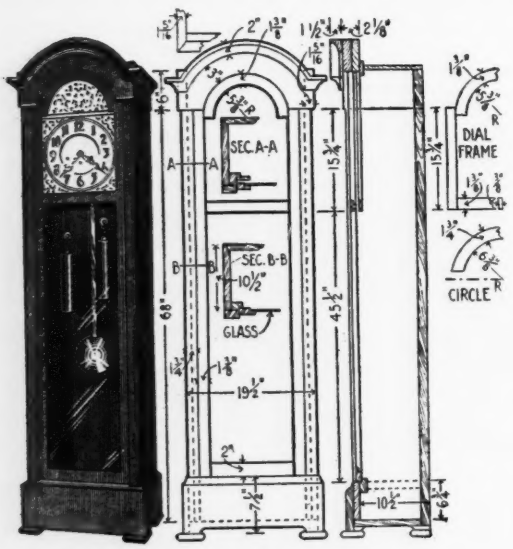
against the gage drawing line; then hold the frame firmly with one hand and with the other slide the angle to the right. Continue this process by first moving the frame, then the triangle, for consecutive spacing.

To make alternate spaces of a different width the slide *C* is used. To operate this slide place one finger on it and move the frame to the right until the gage is struck; then release the slide and it will be drawn back by the rubber band in the slot *D*. This operation is repeated as the lines are drawn.—R. B. Boyd.

Making a Mahogany Case for a Grandfather's Clock

ALMOST appreciated piece of furniture is a grandfather's clock; and to make one with your own hands adds much to its value. The design given is very appropriate, but it may be altered to suit particular needs and to fit a nook most suitable for it. The works for such a clock can be purchased at a nominal price. Any wood may be used in the construction of the case—mahogany or oak being preferable.

For a clock about 7 ft. high, follow the dimensions as given in the illustration. The cross-section *A-A* shows how the waist sides and pilasters are joined and glued together. Another cross-section is shown at *B-B*. The lower front rail is fastened to



Dimensions of the clock case and cross-sections showing the manner of joining

the sides with two dowels at each end and a screw is turned in between the dowels to draw the rail up to the pilaster.

The baseboard is molded on its upper edge and scalloped on the lower part. These pieces are fastened to the sides with glue and screws. To obtain a neat fit the front is first mitered and fastened in place, then the sides are fitted to the miter of the first piece. The bottom, which can be made of poplar, is screwed in place to help strengthen the base. A strip is temporarily fastened with screws across the top and on the inside of the pilasters to hold the sides together while the hood is being fastened in place.

The hood-front is made up of two pieces, the outside stock being the same as that used for the clock, and the inside of poplar. Miter the front piece and glue on the second. Miter and fit the hood-returns. Rabbet out the top and back edges for the top and back to set in. Lay off the circles and cut with a band saw to the line, and smooth with a sharp spoke shave.

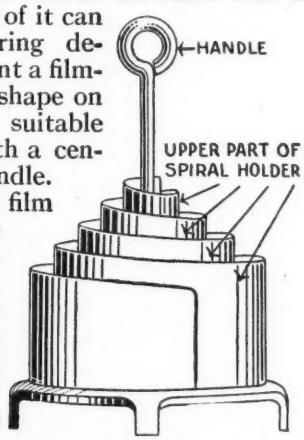
Care should be taken in clamping the hood-returns to the front not to draw them too hard on the clamp as the circle may be contracted and held there after the glue has hardened. Size all miter joints before gluing. The hood or arch molding is laid out on a piece of board 24 in. long, 8 in. wide and 1½ in. thick. The mold is cut at a mill. Care should be taken to have everything square and all joints tight, as any imperfections will show up badly. All joints in the doors should be strongly mortised; but the tenons should not pass through the stiles. The arch rail should be cut at a mill.

When gluing and clamping the door, place it on a level surface to avoid a twist and be sure that it is square. The door sets back from the pilasters ⅜ in. and three extra wide hinges should be used to swing it clear of the hood and pilasters. Rabbeted strips are fastened with screws on the inside of the pilasters for the door-stop. Two of these are fastened on the sides and one across the bottom. Two others on the sides extend from the center rail up, for the dial frame to rest against. The dial frame is for holding the dial. It should fit the hood and sides neatly. The joints should be strongly mortised. The back may be made of poplar either paneled or in one piece.

The finishing and staining are accomplished the same as for any other home-made piece of furniture. It is always necessary to have a smooth surface on all the pieces for any kind of finish.

Developing a Long Photographic Film in One Piece

THE device illustrated is useful in developing kodak films. A long film may be developed and at the same time a sufficient portion of it can be watched during development. Mount a film-holder of special shape on a base having suitable legs, together with a central rod and handle. Unwind a roll of film and remove the paper backing. Wind the film around the upper part of the spiral holder, one end being secured by a small clip. Thus disposed the film is pushed down flush with the top edge and secured, if need be, by other clips. After the developing the film can be readily lifted out and treated in other baths.



The long film is developed in the spirals of the holder

A Perfect Five-Pointed Star Drawn with a Compass

WITH a compass draw a circle. Divide its periphery into 5 equal parts, stepping it off with a divider, and number the division points from 1 to 5. Draw a straight line from division point 1 to 3, from 2 to 4, 3 to 5, 4 to 1 and from 5 to 2. The result is a perfect star, the size of the star depending on the size of the circle.

The Amount and Distribution of Water on a Farm

AFTER a pure water supply for the farm is made available, the things to be considered are the quantity of water needed, choice of pumping equipment, and means of storage and distribution. The quantity required depends on the power used and whether the service is for the entire farm or for the house only. Hand-operated systems are applicable where small quantities are required for house service only; but in case water is wanted for stock, also, the use of a windmill, engine, electric motor or hydraulic ram is necessary. If a windmill is used the storage should be large enough for at least three days' supply, to provide water in case of calm weather Where the other sources of power are used the storage capacity need not exceed one day's supply. The following table gives approximate quantities of water required per day:

Each member of the family for all purposes	25 to 40 gallons
Each cow will require	12 "
Each horse will require	10 "
Each hog will require	2½ "
Each sheep will require	2 "

The water consumption will vary from day to day and with the seasons. Fire protection should also be considered, and in determining the size of tank the maximum amount likely to be required should be provided.

For a family of 6 persons a 200-gal. supply should be sufficient if the water is used for the house only. On a farm where water is supplied to a family of 6 persons, 10 horses, 12 cows, 25 hogs and 15 sheep, the daily storage supply should be at least 500 gal., exclusive of the amount provided for fire protection.

Removing a Heavy Truck-Wheel Without a Chain-Block

THE body of a motor truck usually overhangs to such an extent that it is impossible to use the chain-blocks for removing a heavy wheel. The method illustrated has been used with excellent results, and it requires the services of only one man. The wheel is jacked high enough to put a plate and rollers under it. The plate should be about 18 in. square and ⅜ in. or more thick. The rollers are made of 1-in. pipe 18 in. long. The car is lowered until the wheels rest on the plate and it can be easily pulled out on the rollers.—LESTER JONES.

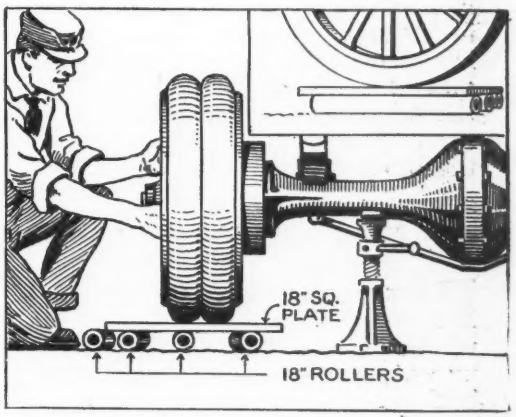
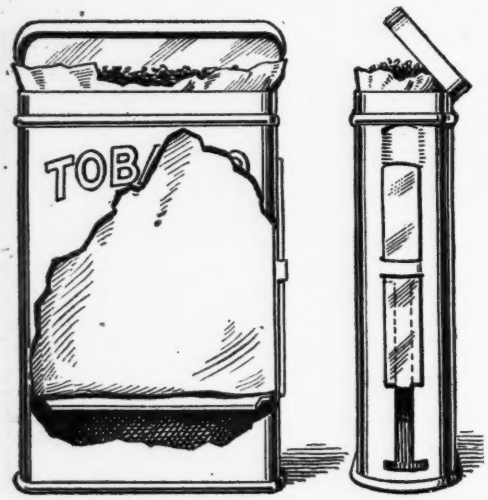


Plate with rollers beneath to make a movable platform for removing a heavy truck-wheel

Keeping the Tobacco at the Top of the Can

THE man who smokes a pipe and buys his tobacco in the "neat little tins" will save himself cut fingers and perhaps a degree of lost temper if he



A movable auxiliary bottom to raise the tobacco in the can as it is used from the top

will equip his tobacco can with an arrangement similar to that shown in the accompanying drawing. A groove is dented into one side of the can and a sliding strap of some fairly stiff metal inserted in the groove under a loop which is cut as shown. The strap is bent, half of it being inside the can. When a little of the tobacco, which is contained in a snug fitting paraffined paper bag has been poured out the metal strap is pressed upward, bringing the level of the tobacco even with the top of the can. This can be repeated as the tobacco is used until the can is empty.

Keeping Your Plants Watered While You Are Away

IF you are going away from home for a few days and are afraid your choice window plants may suffer for lack of water, place the plants around a large bucket filled with water, drop one end of a piece of yarn to the bottom of the water, and lay the other end on the earth around one plant, using as many pieces of yarn as you have plants. Sufficient moisture will thus be carried to the soil to keep the plants in excellent condition for a long time.—H. C. FRANKE, JR.

Using Dirty Waste Oil from Automobile Crankcases

OLD, dirty and worn out oil, drawn from automobile crankcases, drip-pans and other sources need not be thrown away. It can be mixed with coal dust and screenings and used for fuel. Use a pint or more with each hod of screenings, mixing well, so as to make a dry pasty mass that will barely hang together. In this way two otherwise useless products may be satisfactorily employed as a fuel.—JOHN HOECK.

An Adjustable Shingling Jack for Sloping Roofs

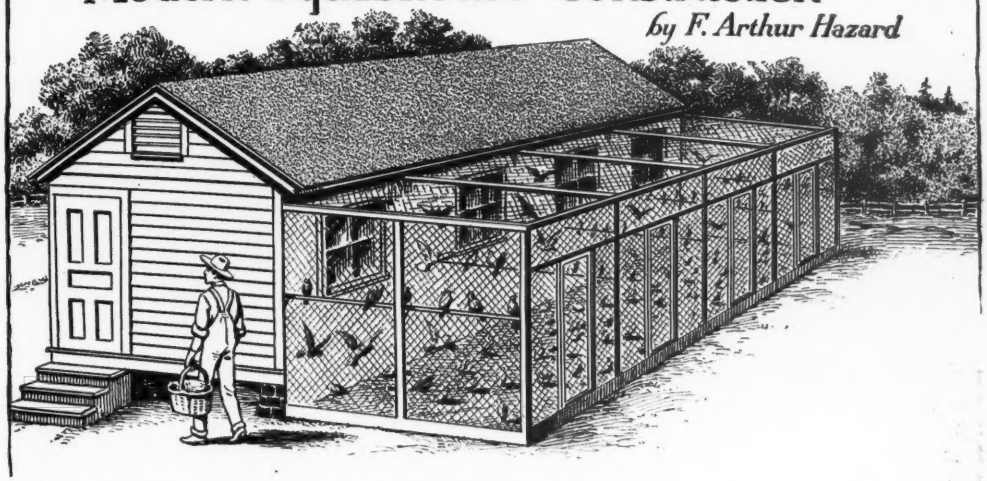
THIS jack is arranged so it can be instantly fitted to any pitch roof by simply loosening the lock nut on supports and raising the seat to the proper angle, then tightening the lock nut. The roof iron is made from ¼ in. by 1 in. band iron and shaped like the sketch with the points sharpened to keep it from slipping in the roof. The hinges are cut from an old 4½ in. by 4½ in. door butt and notched out to receive the adjusting rods, which are made of ¼-in. gas pipe which has been threaded up about 2 in. and split with a hack saw, as in the sketch. The button adjuster rod is of solid iron ¼ in. in diameter and filed to slide into the ¾-in. gas pipe. The

The supports have threaded adjustments like a turnbuckle to raise and lower the seat

hinges are bolted on the seat and roof iron, and the measurements are from center to center. This jack was made with no other tools than a hack saw and a flat file.

Modern Squabhouse Construction

by F. Arthur Hazard



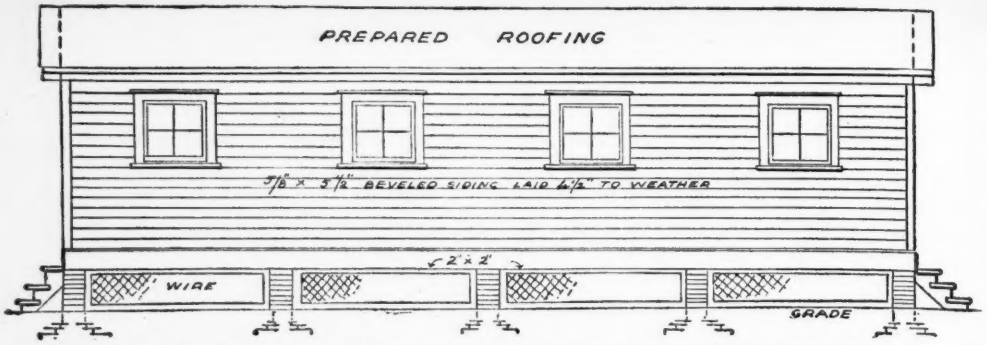
GOOD birds deserve good homes, and to do their best work they must be comfortably housed. The house shown in the illustrations is known as the "unit" squab house. For instance, if a man has but a few birds, pen No. 1 will be built. As soon as there has been saved a goodly number of youngsters from the best pairs, pen No. 2 will be constructed, and so on until there have been built as many units as are deemed necessary. The size of each pen is 10 ft. long and 8 ft. wide with a 3-ft. passageway in the rear, which makes the total depth of the house 12 ft.

In the construction the use of brick piers is recommended, as they will last a life time; but sound cedar posts 12 in. square may be used instead. If cedar posts are used their lower ends should be buried in the ground to a depth of 3 or 4 ft. Upon these piers are placed the 6-in. square sill. The joists are pieces 8 in. wide and 2 in. thick placed on the sills 24 in. apart between centers. As soon as the sills and joists are laid, the floor should be put down. The subfloor should be laid diagonally, as in laying that of a house; then upon it is stretched a very fine mesh screen of galvanized poultry wire. This serves as an excellent protection against rodents. The top floor is laid upon this wire. Culled roofing boards or sheathing may be used for both floors, unless a better grade of lumber is preferred.

The outside studs are all 8 ft. long and by ordering them in 16-ft. lengths there will be less waste of material. The rafters are all cut from 8-ft. pieces. The plates are studs laid double. Another stud is placed on the floor under the ends of the outside studs to give a better bearing surface. The studs and rafters are both placed 24 ins. on centers. The roof is first covered with culled boards placed diagonally on the rafters; then these are covered with a good grade of prepared roofing. It is not best to put on an inferior grade, such as three-ply tar paper, as this will only last 8 or 10 months. No part of the building will need repairing as often as the roof. Thin beveled siding is recommended for ease in working and the neat appearance of the finished job. Sheathing should be placed on the studs on the inside. If a good, warm house is desired, place sheathing under the siding also and fill the space between them and the plates with cinders.

The windows are stock sizes, which are not very expensive. These are hinged at the top on the inside and they swing up and in. By means of cords and pulleys they can be operated very easily from the passageway. This eliminates having to go into the pen on cold nights to shut down the windows, and possibly scaring the birds. In each gable is placed a louvre ventilator, the back of which is covered with No. 1 wire mesh to keep out sparrows and other small birds. These louvres will ventilate the building at all times.

The nests shown are double, each

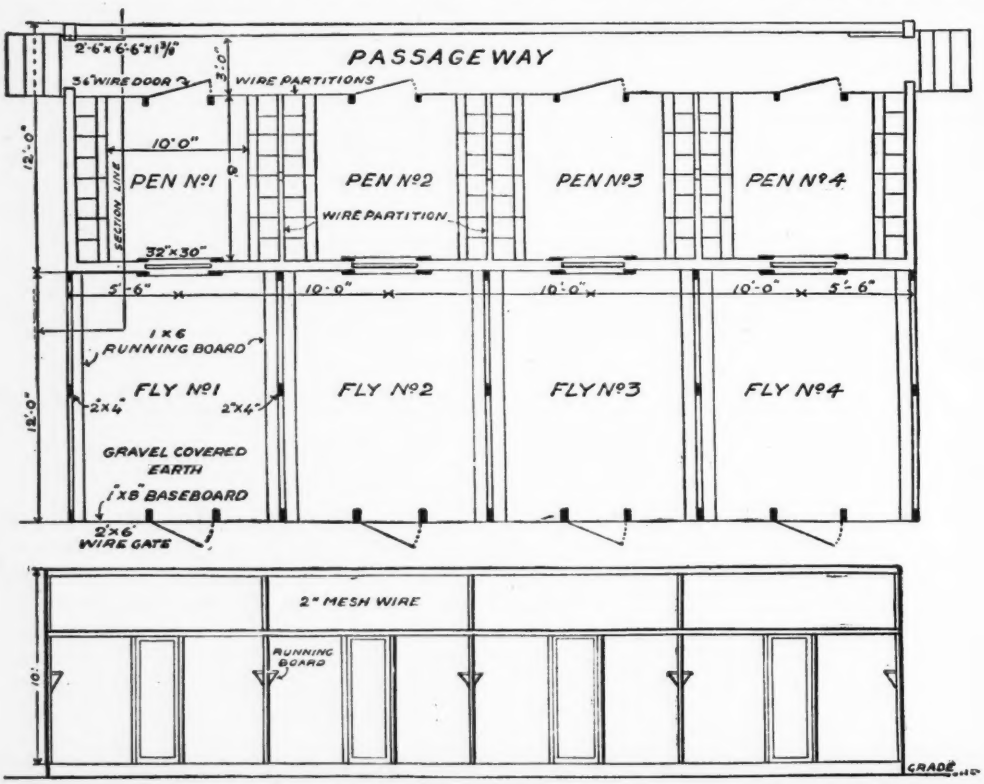


Elevation of the house showing the construction and location of the brick piers beneath the ends of the partitions between each of the pens where they support the ends of the sills

pair having two nests adjoining. Between each pair of double nests there is an upright. This keeps the cock birds from fighting. A glance at the plan and then at the section will show the good features of the double nests. In placing the nests as shown there is no draft across any nest box—a decided advantage. This pen with its arrangement of nests will easily accommodate 50 pairs of breeders.

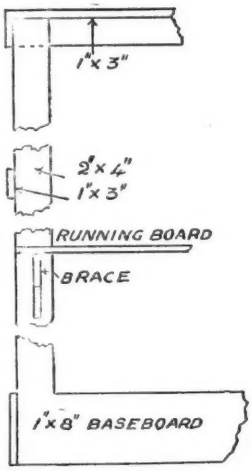
Under the bottom row of nests should be placed a crate containing plenty of nesting material. This is an absolute necessity and must not be overlooked. Beneath the house and at the back of the fly is placed a frame made of 2-in. square material on which is stretched a 2-in. wire mesh. These frames fit in between the brick piers.

The fly pens are constructed of studs, which form the uprights. Around the base of the pens is placed a board 8 in. wide. The tops of the uprights are



Plan of the pens and flies with dimensions and a sectional view showing the location of the doors and the running boards, one of which is provided on each side of each pen

fastened together and held in place by two pieces, or strips, 3 in. wide by 1 in. thick. One piece is nailed along the top and the other along the edge on front and sides. The gates are made from 2-in. square material 6 ft. high, swung between posts made of studs. At the top of each gate is placed another 3 by 1-in. strip; as shown in the illustration. Each pen is provided with a running-board on each side. This is 6 in. wide and 1 in. thick, placed 5 ft. from the ground where it is carried on wooden brackets. The whole fly is covered with wire netting, preferably of 1-in. mesh. The 2-in. mesh is good but it allows sparrows to get in.



Detail of the supports and running board in fly

This house, if properly built, will accommodate 200 pairs of breeders with ease. The cost should be very moderate and it has every good feature which could be demanded in a modern squab house.

Locating Electric Conduits in Old Walls

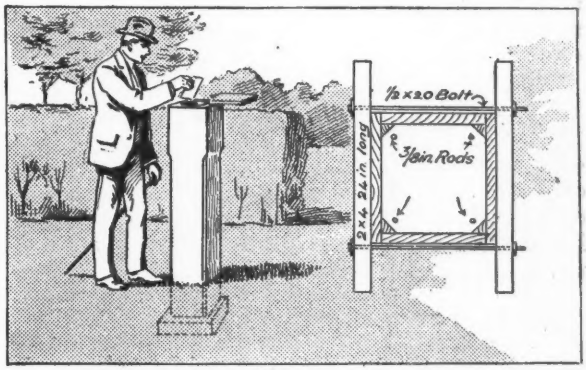
WHEN necessary to find a conduit for repairs or removal, the tearing up of flooring or plaster is unavoidable if the location is not marked. To do this quickly and with little trouble, use the ordinary compass. Locate the cable as near as possible, then place the compass close and keep it on the move until the needle will not deflect in either direction. The cable will be found directly beneath the compass when the needle stands in this position. It is necessary to have a current flowing through the wires in the cable to produce the magnetic field for moving the compass needle as there is nothing in the cable sheath to cause it to turn, most sheaths being made of insulating materials and not metal.

A Concrete Letter Box in the Form of a Post

THIS concrete letter box is like a large concrete fence post with a hole in the top and a hinged lid to cover the opening. It has been used for years. It does not leak, it looks good, and will last forever.

Make the molds of wood. The underground portion of the letter box should be at least two or three feet deep to a solid footing and below the frost line. The outside dimension of the square concrete is 12 in. and it need not taper. If desired, the exposed corners may be beveled with an edger. The hole in the top is 8 in. in diameter and 14 in. deep. A heavy bolt is placed in one corner of the top of the post so that the lid can be swung upon it. Reinforce the corners with ⅜-in. round steel rods running the full length of the letter box, which is about 3½ in. above the grade line.

In the mixing of the concrete, if unscreened "bank run" gravel is used, it should be mixed in the proportion of one to four. Crushed rock or screened gravel and coarse sand are better for concrete work, and if such materials are available use a one-two-four mixture for the buildings of this simple but durable letter box for the farm. Tamp the sides of the forms lightly so as to remove the air bubbles in the concrete and force the gravel towards the inside. Use an old piece of 8-in. drain tile for making the hole in the top which will hold the mail. The cover is made of concrete and is reinforced with a wire netting. A round metal pin fastened in the cover fits in a hole in the post top to provide a way for swinging it from over the hole.

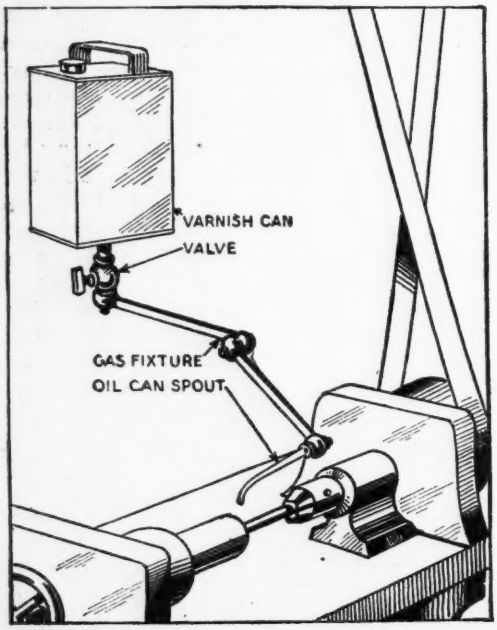


The letters are dropped into a hollow in what resembles an ordinary hitching post

A Novel Lathe Tool Oiler Made of a Varnish Can

A RECENT lathe job required constant oiling of the work, and the oiler described here was constructed from spare parts and still gives excellent service.

The container for the oil was an old varnish can carefully cleaned. Soldered into its bottom was a short length of ½ in. iron piping, threaded to take on its lower end a folding gas bracket, as shown. Where the burner is usually screwed on the spout of an oil can this one was soldered on.



An old varnish can used for an oil reservoir to supply lubricant to the cutting tool

The can hangs on the wall back of the lathe and it is a simple matter to place the stream wherever required. A similar oiler was constructed for use with the drill press, with the exception that a curved oil can spout was found necessary in order to get the lubrication close to the drilling.—THOMAS W. BENSON.

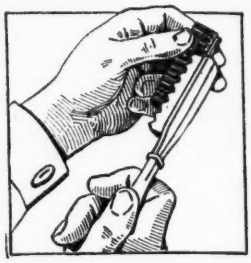
An Easy Way to Cut a Circle from a Glass Plate

A CIRCLE of glass is generally cut with a compass attached to the cutter, but if none is handy, draw a circle on paper, then lay the glass over it, take an ordinary glass-cutter and follow around the line. The circle may not be absolutely true but if a little care is taken it will be fairly accurate.

If the cutter is dipped in turpentine or kerosene before using, the work can be accomplished more easily.—C. H. D.

A Tooth-Brush with Removable Bristle-Pad

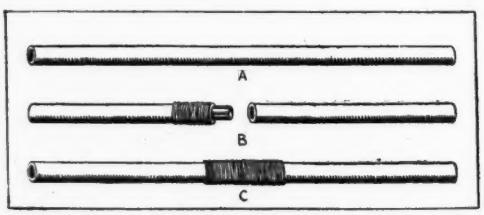
THE novel feature of the brush shown in the illustration is that the brush part is separable from the handle. The bristles of the brush are fastened to the sides of a small block that slides into the space on the handle provided for it and is held in place by the small ring on the handle, which is slipped up to draw the parts together like a clamp. The handle may be as ornamental and strongly constructed as desired, for it is not discarded when the bristles are worn out.



The brush part is easily slipped out

A Method of Mending a Leaky Garden Hose

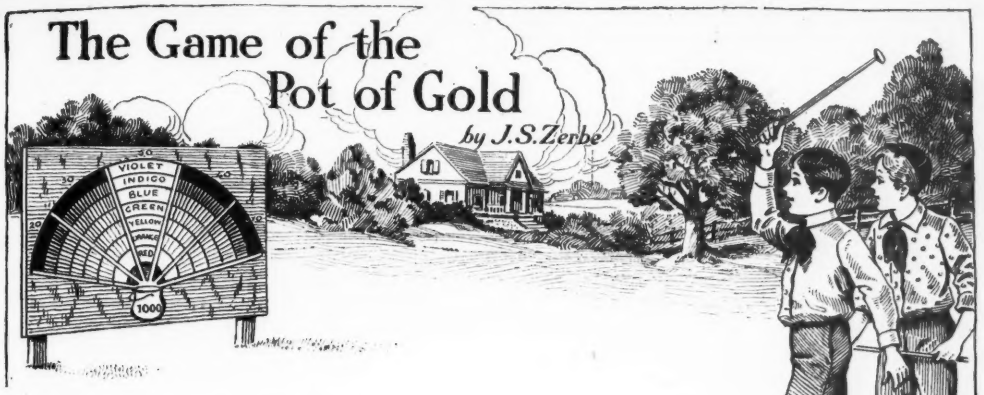
THE illustration shows how a leak in a hose can be mended satisfactorily, and how two pieces of hose may be securely joined together. The leaky hose is shown at *A* and the repair is started by cutting it in two, *B*. A piece of pipe is then inserted in one end and the two ends joined over it and tied, *C*. Old brass picture rods, curtain poles and the light iron piping that is used for carrying electric wires into a house, all make good material for this job. The only point is that it must fit inside the hose. If this work is done well, the hose will be as good as new, and can be made to last for a considerable length of time.—DR. L. K. HIRSHBERG.



A tube is inserted in the hose ends with the joint centering and then firmly wrapped

The Game of the Pot of Gold

by J.S. Zerbe



ROMANCE and fable say there is a pot of gold at the end of the rainbow. Here is a description of a new game bearing that name, in which are combined the elements of chance and skill. It is an open-air as well as an indoor game, and aside from the actual sport of putting the shots great interest is excited in figuring up and combining the counts which are available in the game.

The regulation target for outdoor sport is 7½ ft. long and 4 ft. wide, mounted on posts 2 ft. high. The indoor target is 3 ft. long by 20 ins. wide. On the background thus provided is painted the segment of a rainbow, the outer rim of which describes an arc of a circle 6 ft. in diameter. The arcs of circles which represent the seven colors of the rainbow, are 4 in. apart, and these are numbered successively from the red band 5 to the violet band 35.

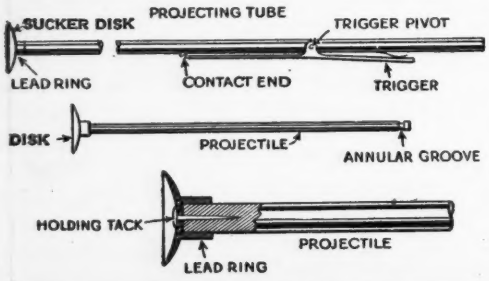
This rainbow field is divided by radial bars, each being 1½ in. wide, and ¼ in. thick. There are thus five segmental spaces, the middle one being numbered 50, the two on opposite sides 30 and 40 respectively, and the extremities 10 and 20. The projectile is an adaptation of the old leather "sucker" with which boys are familiar. The stem is a turned piece of soft wood, ⅜ in. in diameter and 14 in. long. A short section of lead pipe is driven on one end, and a rubber sucker disk, dished as shown, is secured to the end of the stem by means of a large-headed tack. The lead ring serves two purposes, to give the necessary weight to the end of the stem and to prevent the end from splitting when the tack is driven in.

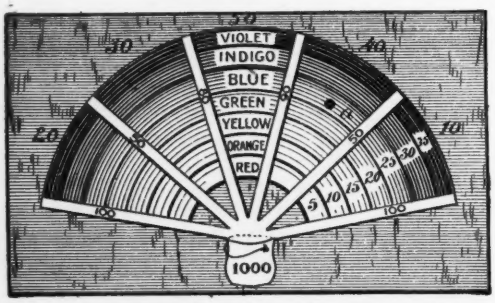
It should be observed—for this is one of the features of the game—that the diameter of the disk is not greater than the width of the radiating strips which run across the rainbow. The throwing device is a tube 2 ft. long, with a bore of the proper size to receive the stem. The rear end of the stem has an annular groove, and a hole is made through the wall of the tube to coincide with the location of the groove when the stem is in the tube. A trigger is hinged to the tube midway between its ends, one end thereof having an in-turned bend, so it will enter the hole in the tube and rest in the groove of the stem, while the rear end of the trigger is within reach of the forefinger of the thrower when it is grasped by the handle of the tube.

The ability to release the projectile at the proper time by pressing the trigger is only one of the fine points of the game, but this is soon acquired, as well as the speed with which the missile is thrown. The counting system may be varied by the players, but the approved plan is here outlined. As each projectile has a certain number its striking position on the target is an important factor. Assuming that the stem numbered 4 is thrown, and strikes and sticks on the blue at *A* the value of the blue is 25, which, multiplied by 4, equals 100; but being in the sector space 40, it must be diminished by that number, leaving 60 as the result. If the shot had landed on the blue in the sector 10, the result would have been 90. If in sector 50 the result would be 50. The rule of the game, therefore, is as follows: Multiply the value of the rainbow color with the

number of the projectile, and subtract therefrom the sector number.

It will be observed that the radially-placed strips on the target are numbered. The two at the extremities are 100,





The arrangement of the color arcs on the board and details of the projectile and thrower

while the intermediate strips are 50, 80, 90 and 50 respectively, the first strip at the left being the sum of the sector numbers 20 and 30, the second strip the sum of the sectors 30 and 50, and so on. As the sucker disk is only slightly smaller in diameter than the width of the strip, it is obvious that the disk will not adhere unless it strikes the strip fairly between its edges, so that any one performing that feat is entitled to a high score. This is determined by multiplying the value of the strip by the number of the projectile. If the missile should strike the pot of gold the throw would be valued 1000.

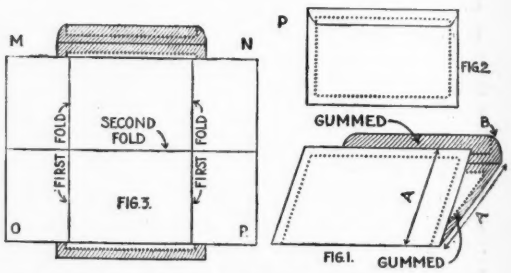
Instead of playing alternately, each thrower uses the six projectiles which are assigned him, which may be marked from 1 to 6, or any other numbers; but all the players should have the same numbers. This arrangement of the scoring numbers, combined with the values of the projectiles and the rainbow arrangement, distributes the amounts capable of being gained by the combined shots, so that a poor thrower stands a better chance of evening up with an expert handler of the projectile.

An Improvised Trouble Light for Motorists

MANY times a motorcyclist, or even an autoist, is caught on the road at night with tire trouble and finds himself without a trouble light. In this difficult situation, scrape up a small pile of sand. Pour about a cup of gasoline on it, and touch a match to it. This will burn for fifteen or twenty minutes and will provide sufficient light to make the repair.

A Safety Envelope that Affords Real Protection

A SAFETY envelope is intended to give additional protection against opening by an intruder. In the one illustrated in Fig. 1, parts *A* resemble the usual kind with perforated edges, but there is also used the flap *B*, this being also gummed and perforated and folded over at the last. The whole is shown in Fig. 2 with the flap pasted down. The perforations *P* in the flap come just over the other perforations, so that this end can be torn off as usual. Another method is seen in Fig. 3. The same envelope is used, and it is spread out flat. Upon it is pasted a square of preferably thin paper MNOR, which is opaque on the under side. This sheet is written upon and then folded over as seen in the vertical lines, so as to be somewhat smaller than the envelope; then the latter is folded as before and pasted, but now the edges need not be

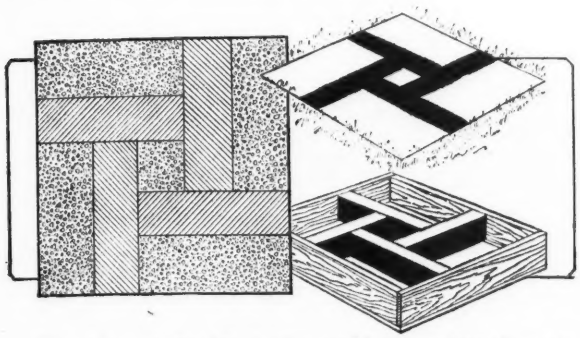


A perforated opening line to prevent contents of an envelope from being tampered with

pasted, because the folded paper answers the same purpose and gives a tight edge, and an attempt to draw the paper out at the sides would be detected as readily as would the actual opening of the envelope.

An Effective Garden Path of Brick and Concrete Block

IN this method of making a walk, many of the old ideas have been brought into use, but with added features to insure an artistic effect. The illustration depicts the construction of a block that can be easily made and will present an appearance in harmony with any well-ordered surroundings. It is made of brick and a concrete mixture. To give it a square shape a form must be used, which is easily constructed with boards. The size of the bricks will determine the size of the form. Make a square base from one or more boards and strengthen it with cleats across the bottom. Make a square box without top or bottom to fit neatly on the base. Dowels or guides should be used to return the base in the proper place each time it is set for a new block. The height of the sides for this box should be equal to the width of the bricks to be used.



The plan of the block, the mold for making it and the appearance of the completed square in use

The bricks are set in the form as shown and the concrete mixture poured in the open spaces around them. The richness of this mixture will depend on how well the block is to be made. One-to-five mixture may be used for the bottom and should be well tamped in. The finishing surface is filled with one-to-two or one-to-one using only sand to make a smooth surface. The top is struck off and troweled down smooth. While damp the mold box should be removed, allowing the block to set aside until it hardens. The red bricks showing through the gray concrete in the green lawn is very effective.

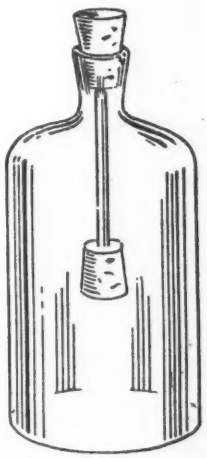
In setting the blocks in the lawn, measure off the distance in steps while walking naturally, marking each place where the foot touches the ground. The stones are placed in these positions in a zig-zag fashion, yet on a straight line. A hole is dug in the turf, removing sufficient dirt to admit the block so that its surface is level with the ground. This makes it easy to cut the grass over the stones without having to trim the edges with a hand sickle.

To make the box-form lift easily from the block, have the sides slightly tapering so that the bottom opening will be somewhat larger than the top. Handles can be placed on the sides to aid in lifting it from the finished block. Where a great many of the blocks are to be made it is well to have the mold convenient and handy to operate.

A Stopper for Poison Bottles Which Works Automatically

AS a safeguard to prevent children or others from accidentally pouring acid or poison from bottles which are thought to contain medicines or harmless liquids, a thin glass tube, on the lower end of which is a cork, can be inserted and will serve as a warning and as a safeguard.

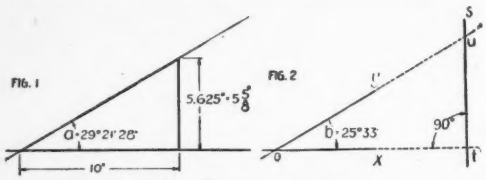
The cork on the end of the tube is forced into the bottle and the usual cork, bored to admit the passage of the tube, is fitted in place. If this bottle is taken in the dark and the cork removed the tube will be forced upwards. This serves as a warning. If an attempt is made to pour liquid from the bottle the lower cork will drop into the neck of the bottle and prevent liquid from flowing out. When the contents of the acid or poison bottle are to be used purposely, the liquid can be drawn by pushing the tube inwards, which forces the cork up out of the way.—R. V. LAWRENCE.



When the cork is drawn out the tube is forced up

How to Plot Angles Accurately in Fractional Parts of a Degree

THE following is a simple and accurate method of plotting angles, especially where they are to be interpreted in fractional parts of degrees



A method of plotting angles where they are interpreted in fractional parts of a degree

which would be difficult to read from ordinary protractors.

As an example let it be required to lay off an angle of 29°—21′—28″. By consulting a table of natural tangents we find the tangent of the given angle to be .5625, and as this represents the altitude of a right angle triangle whose base is unity, it is quite evident that, if we lay off a base line 10 in. long, the altitude will be 10 ins. x .5625, or 5.625 ins., as in Fig. 1.

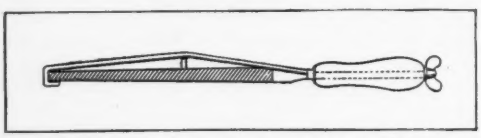
Again, suppose it is required to determine the angle *b*, in Fig. 2.

Lay off on *o*—*x*, or *o*—*x* produced, *o*—*t*, equal to 10 in. and from *t* erect a perpendicular *t*—*s* of any convenient length. Extend *o*—*y*, if necessary to intersect *t*—*s* at *u*.

For reasons previously explained, *t*—*u* is ten times the natural tangent of angle *b*. Therefore, if *t*—*u* is measured and found to be 4.78 in., the tangent of *b* will naturally be 4.78÷10, or .478= 25°—33′.—HARRY B. WRIGLEY.

Bracing the Back of a Long File for Level Work

THE drawing shows a method of trussing a long file so as to make the teeth on the cutting face more effective, and also to produce a slightly



A truss rod placed on a long file to brace it and make the cutting more effective

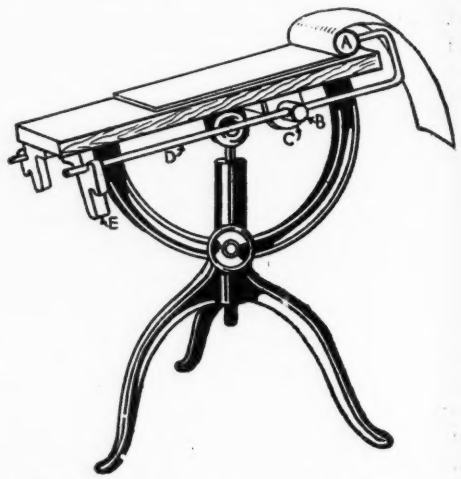
convex surface, enabling the file to be used for broad work without rounding.

A block is placed near the center of the file, over which a ¼-in. or 3/16-in. rod passes. This has a hook to engage the file at the forward end, and passes through a hole drilled in the handle, where a nut is run on the threaded end. By tightening this nut the file may be sprung slightly convex, increasing its usefulness for certain classes of work.

Holding Reference Drawings on a Drawing Board Conveniently

IT is quite necessary to have on the drawing board at times a bound bunch of blue prints for reference and they cannot be kept in place very well on a slanting surface. To facilitate their easy handling and hold them in place the arrangement shown was constructed.

It consists of a wood cylinder *A* about 1½ in. in diameter and about 24 in. long,



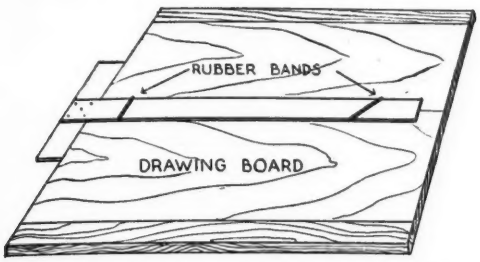
Clamp arrangement to hold a bundle of reference blue prints on a drawing board

supported by two ⅜-in. bent rods which are fastened to the bar *B*, the latter being supported by two brackets *C* fastened to the bottom side of the drawing board.

A rod *D* is fastened to the bar *B* and extended to a convenient point at the front of the drawing board. The rod *D* is held in position by the hook *E*, which is double, the same as the brackets *C*. To release the drawings unhook rod *D* and move it downward. The rod *D* can be bent so that when it is in the hook it will bring the proper pressure on the cylinder *A* to hold the drawings in position on the board.

To Prevent a T-Square from Slipping on a Drawing Board

TO KEEP a T-square from slipping on a sloping board, especially where the angle is 45 deg. or more, place



The rubber bands on the blade of the square keeps it from slipping on the board

two ordinary rubber bands on the blade, one near the head and the other at the end. These bands will also keep the blade up from the drawing surface and well away from the freshly drawn ink lines.—JOSEPH BRISCOE, JR.

A Home-Made Fireless Cooker for the Camp

ON a camping trip, any suggestion which will tend to reduce the labor of cooking meals is generally welcome. One of the easiest ways to cook meals in a satisfactory and thorough manner is with a fireless cooker. It is a simple matter to make such an article, the only materials necessary being a barrel, a tin pail with cover holding about 8 quarts, some strips of asbestos paper, plenty of old newspapers, a few pieces of cloth, and some flour to make a paste similar to that used by paper-hangers. If the newspapers are lacking one can use hay or pine needles.

After collecting the necessary materials start the construction of the cooker by sawing the barrel in half. Cover the bottom with a 2-in. thickness of newspapers and lay a few sheets of asbestos paper on top. Then place the pail, after wrapping with several thicknesses of asbestos paper, in the center of the barrel. Pack newspapers all around the pail, pressing them down as tight as possible. It is advantageous to pour a little paste in with the newspapers from time to time in order to make a compact mass. When the packing reaches the level of the top of the pail, pour plenty of paste over the papers and let the whole harden.

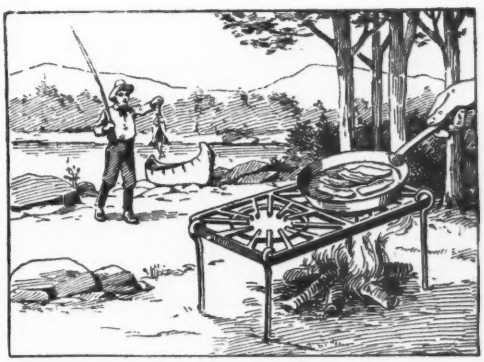
For a cover to the cooker, make a bag which will fit inside the barrel and which will completely cover the pail. Fill the bag with newspapers, making a compact pad of at least a 3-in. thickness. This pad can be nailed to the head end of the barrel.

After the paste has dried completely, remove the pail from the packing, taking care that the sheets of asbestos remain to form the lining for the mold in which the pail is set.

To use the outfit, start the food, which is to be cooked, boiling over the fire in the cooker pail. When it is boiling well, put it into the mold of the cooker and place the padded cover over the pail. A large stone will keep the cover pressed firmly down onto the pail so that no heat will escape. Let the meal cook all night or all day, having no fear that the contents will be cooked too much. The most delicious boiled dinners, cereals, etc., can be cooked in this manner with the expenditure of little time and energy, so that one may enjoy the camping trip to the utmost.

Portable Stove for Campers and Automobilists

A SIMPLE portable stove can be easily made out of an oil-stove top and four iron rods. The rods should be sharpened at one end, so that they may be easily driven into the ground when they are to be used. The other

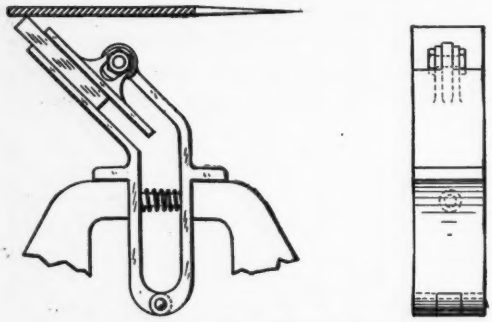


The top of an oil stove with four rods for legs makes a convenient stove for campers

ends are bent into a loop surrounding the metal of the stove-top and supporting it when the stove is in use. All that is necessary in packing the stove is to fold the rods in. The stove then becomes a flat piece taking up very little room.

A Filing Clamp for Use in the Jaws of a Vise

THIS device is used in an ordinary bench vise and used mostly by tool makers or gage makers. It is not well known to ordinary shop men, but is



An angle clamp to hold in a vise for gripping parts requiring the filing of arrises

very practical on gages and other work requiring filing of arrises as it does away with filing up or down. Its use is unlimited. The upper jaw is adjustable to different thicknesses of stock. If made of cast iron and polished it makes a very neat tool.—FRED FRUHNER.

How to Remove Stains from Various Kinds of Cloth

BLOOD stains when fresh and still wet, can be removed by dropping hydrogen peroxide on them. If old stains, cold water and soap are most effective.

BLUEING: If clothes are streaked or spotted with blueing, boil them in dilute acid, using about a teaspoon of muriatic acid to two gallons of water.

CHOCOLATE stains should be removed from clothing before it is washed, as hot water and soap set the stains. If washed while fresh with cold water and soap, no stain will remain. If it is an old stain, boiling in Javelle Water will remove the stain but may be injurious to the fabric.

COCOA stains should be treated the same as chocolate stains.

COFFEE stains should be treated the same as chocolate stains.

DYES: Clothes are sometimes splashed with dyes in dyeing at home. These splashes can be readily removed by soaking them in ammonia water.

FRUIT stains of all kinds, peach, grape, cranberry, etc., can be removed when they are fresh, by pouring boiling water over them. If the stain is old, the only way to remove it is by boiling it in Javelle Water, but this is apt to be injurious to the fabric, and will remove the color in any colored goods.

GRASS stains, when fresh can be removed by soaking in alcohol. If the stains are old, rub with molasses and allow to stand several hours before washing out.

GREASE spots can be removed with gasoline or with ether. But careful manipulation is necessary. Gasoline and ether must be kept away from any flame. Pour enough gasoline or ether on a tablespoonful of starch to make a paste, place the paste on the under side of the spot and allow to remain several minutes. Brush off the starch when it is dry. Ether evaporates more rapidly than gasoline and leaves no unpleasant odor.

INK SPOTS: Ordinary ink (not indelible) can be removed by using this homemade ink eradicator:

Solution 1. Put 5 teaspoons of acetic acid (which can be purchased at the drug store) into a glass measuring cup, add water enough to make half a cup of liquid. Put in a bottle, cork it well, and label "Solution 1."

Solution 2. Put one tablespoon of fresh chloride of lime into a granite pan with half a cup of water, boil until a pink color appears, then strain through a fine cloth. Add ¼ cup cold water, place in a bottle, cork well, and label "Solution 2."

In using this eradicator, apply solution 1, let it stand a moment, soak up with a blotter, then apply solution 2, let stand a moment, then blot up. If the spot is not gone, repeat. This solution is injurious to silk, and will take the color out of delicate fabrics.

IODINE spots can be removed by swabbing with alcohol on a piece of absorbent cotton, or better, by placing on the spots a paste made of starch and cold water. This will form a blue spot, which can easily be washed out with cold water.

IRON RUST can be most easily removed by soaking the spot for a short time in dilute muriatic acid (one part acid to one part water). Be sure to wash the acid out thoroughly or it will rot the fabric. Rinse in ammonia after using acid on any fabric.

MEDICINE stains will almost all dissolve in alcohol.

MILDEW can be removed by soaking in Javelle Water (see recipe below), and then hanging in the sunshine. If not all removed the first time repeat the treatment.

MILK can be easily removed while fresh with cold water and soap. After milk has been boiled into goods it is almost impossible to remove, although boiling in Javelle Water (see recipe below) will sometimes help.

ORANGE stains are best removed by moistening the spot with cold water, and hanging in the bright sunshine.

PAINT, if on cotton or linen, should be soaked in turpentine or gasoline. If on silk do not use turpentine; ether will probably dissolve it.

SCORCHED spots from a hot iron can be removed by moistening the spot with water and hanging in the bright sunshine.

TEA stains are removed in the same way as are chocolate stains.

VARNISH spots are removed the same way as are paint spots.

RECIPE FOR JAVELLE WATER: Put one pound of sal soda in two quarts of boiling water, stir till dissolved, add ¼ pound of chloride of lime, stir well, let settle, pour off the liquid, being careful not to get any of the powder settled out in the bottom. Put in a bottle, cork well, and label. It is safest to dilute this with an equal part of water when using.

Making a Tap and Die for Emergency Work

ANY amateur, handy with a file, can make an excellent set of taps and dies from ordinary bolts and nuts. Secure a bolt and nut of any size. With file cut three grooves equally distant from each other in the bolt thread, as in an ordinary tap, following out the same process in the case of the nut.

Tap and die made of bolt and nut

The tap and die should be case-hardened, and suitably tempered, which is done by heating them until they become red and plunging them suddenly into cold water. A spanner of suitable size will be found necessary for turning the tap.—GEORGE H. HOLDEN.

A Brad Awl Made From a Button Hook

IN CASE the awl has been misplaced or lost, one can be made from the ordinary button hook for shoes. The hook part is filed off and the end is sharpened to a point. The handle on the hook makes it convenient to hang it up over the work bench.—TOM DEAN.

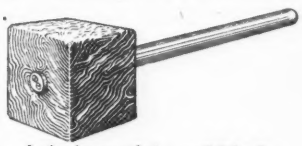
The shank of the button hook is filed to a point after the hook end is cut off

A Bulletin Board for Making Sales of Farm Produce

A BULLETIN board erected at the entrance of any farm serves the farmer in many ways. The enterprising farmer can utilize the automobile traffic which passes his place by posting on his bulletin board that he has fresh eggs, butter, and the like for sale. Many auto parties will stop and buy, feeling sure that they are getting the articles perfectly fresh.—IRA R. ALEXANDER.

An Emergency Mallet Made From a Broomstick

A QUICKLY constructed mallet can be made by utilizing the remains of an old broomstick. The stick of the broom should be cut off to the length desired (about the size of an ordinary hammer). The head of the mallet is cut from 4 in. square lumber, such as oak or maple, or in fact any hard wood. Drill a 1-in. hole through the head and drive the handle in.



A broom stick and block make a very good mallet

Waste Scrap Leather Used for Shoe Soles

A PATENT has been granted on a method of utilizing waste leather scraps about a shoe manufactory in the making of cheap soles. The scraps are notched along the edges, so that mortises are formed. These mortises fit into each other, making a fairly rigid single piece of leather.

A Clever Woman Discovers Handy Location for the Kitchen Towel

THE kitchen towel should hang within hand reach of the sink, as the cook requires it many times a day. In some

The roller is attached to the ends of the sink drain. The towel thus serves two purposes

kitchens this can be arranged upon a wall rack above the sink drainboard. One clever woman attached a roller-towel rod across the front of the sink, fastening it to the edges of the two wood drainboards. This arrangement makes the towel serve two purposes, as it protects the dress when a person is standing before the sink. When sitting on a stool to wash dishes or to prepare vegetables the towel is drawn up over the lap.—AVIS GORDON VESTAL.

A Method of Keeping a Rabbit's Cage Clean

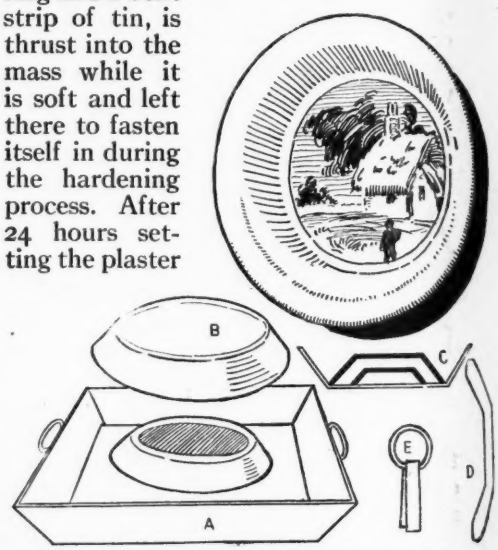
MAKE half of the flooring of a rabbit's cage of slats with ½-in. openings between them and you will never be troubled with cleaning it. Ordinary laths are nailed to the supports for the bottom instead of a solid board. The other half is made solid.—R. L. BIRD.

Holding a Nut Steady Without the Aid of a Locknut

THE old method of battering a bolt-end to hold a nut makes it difficult to replace the nut after removal. A simple way to prevent a nut from turning and still not spoil the threads on the end of the bolt is to bore a hole in one side of the nut and after the nut is turned home, take a small center-punch and insert it in the hole and strike it a few blows with a hammer. The punch will raise a small circle of metal inside of the hole and prevent the nut from turning. When the nut is removed no trouble will be had in starting it true again.

Making Wall Plaques in Plaster of Paris

PRETTY pictures are easily obtained nowadays, but framing them is as expensive as ever. Many magazine covers and illustrations are real works of art and are worthy of a place in the decorative scheme of the home. To frame a picture of this sort plaster of Paris may be used to good advantage. The process complete is shown in the illustration with *A* representing a large pan, in which an elongated dish is placed. The picture to be mounted is first dampened and then pressed flat on the dish with its face down. A mixture of plaster of Paris and water of thick, creamy consistency is then made and poured on the picture. While the plaster is in a soft state a second dish *B* is placed over the mass. A sectional view of this arrangement is shown at *C*, with that of the finished plaque at *D*. A hanger *E* consisting of a ring and a bent strip of tin, is thrust into the mass while it is soft and left there to fasten itself in during the hardening process. After 24 hours setting the plaster

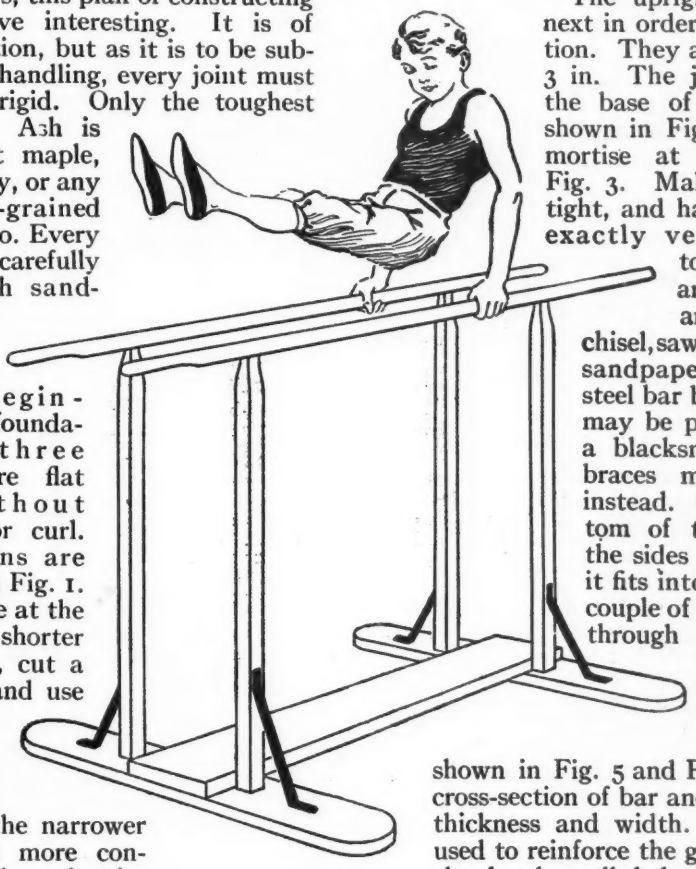


A plaster of Paris plaque with a picture embedded in it and details of the process

is removed by pressing at the edge with the blade of a table knife. The edges of the plaque may be tinted or gilded.

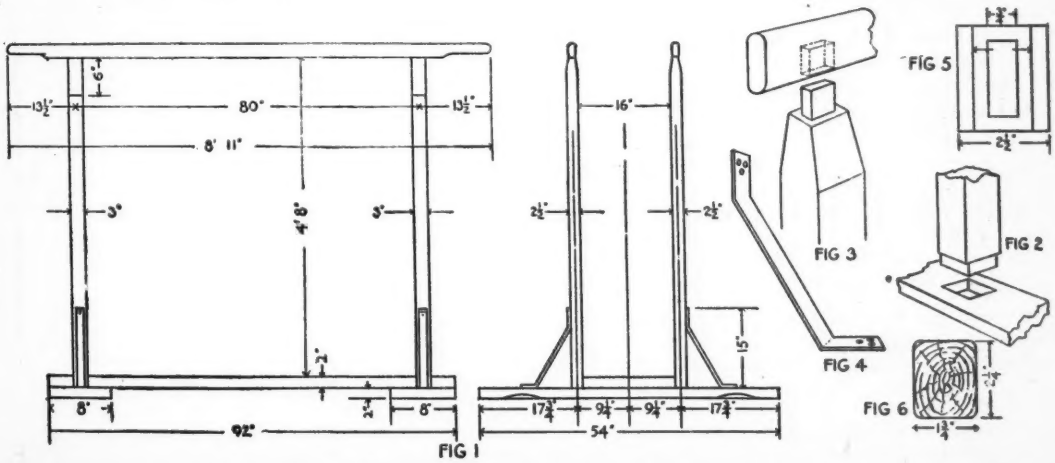
Making Parallel Bars for the Home Gymnasium

AS no gymnasium is complete without parallel bars, this plan of constructing them may prove interesting. It is of simple construction, but as it is to be subjected to rough handling, every joint must be strong and rigid. Only the toughest wood will do. Ash is first choice, but maple, oak, elm, hickory, or any other straight-grained hard wood will do. Every piece must be carefully smoothed with sandpaper and rubbed with successive coats of oil. Beginning at the foundation, choose three planks that are flat and true, without warp or dip or curl. The dimensions are clearly shown in Fig. 1. To get the curve at the ends of the shorter planks uniform, cut a paper pattern and use it for the four markings. Cut to the marks with a common handsaw, but the narrower the blade, the more convenient it will be. A 6-in. groove is hollowed to the depth of ½-in. in the sides of the base pieces, as shown. This gives the base a better grip on the floor and makes a handhold for lifting.



Assembled parts making the parallel bars for the gymnasium

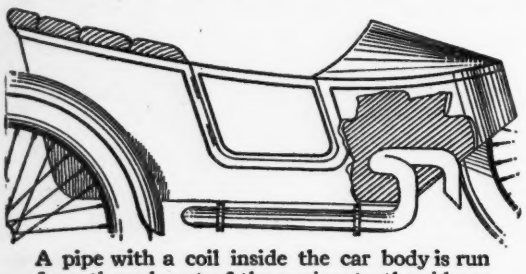
The upright posts are next in order of construction. They are 2½ in. by 3 in. The joint used at the base of the post is shown in Fig. 2, and the mortise at the top in Fig. 3. Make the joints tight, and have the posts exactly vertical. The tools necessary are a brace and bit, wood chisel, saw, hammer and sandpaper. The four steel bar braces, Fig. 4, may be procured from a blacksmith. Wood braces may be used instead. Glue the bottom of the post and the sides of the socket it fits into, and drive a couple of finishing nails through it into the center plank. The dimensions of the top tenon are shown in Fig. 5 and Fig. 6. It is a cross-section of bar and shows form, thickness and width. If nails are used to reinforce the glue joint, sink the heads well below the surface. A thorough smoothing and rubbing with oil will complete the job.



Owing to the rough handling of parallel bars it is necessary to have the parts made of tough wood that is straight grained and put together with mortise and tenon joints and well braced

An Exhaust Pipe Heater for a Motorcycle Sidecar

THE motorcycle sidecar can be made quite comfortable in winter if the exhaust is extended and a coil placed in the



A pipe with a coil inside the car body is run from the exhaust of the engine to the sidecar

front of the car. It requires only a piece of pipe or tubing that can be easily bent into the shape desired. The size will depend on the exhaust opening. A pipe should be secured with an inside diameter the same as the outside diameter of the exhaust. It is then run to the front of the car where it enters. On the inside it forms a coil, the end running through the bottom to the outside.—FRITZ M. MEYER.

Right Pressure for Bead Molds in Making Tire Repairs

IN making sectional repairs, bead molds should be tightened until the cavity is the exact size of the tire. Then an added quarter turn of the clamp screw will give just enough pressure to insure the proper flow of the gum. This turn saves the air-bag considerable strain. However, if much more pressure is exerted there is danger that the fabric or the inside surface of the repaired section will buckle or bulge.

Our Prize Motorcycle Contest

THE Motorcycle Contest has been a brilliant success. It brought from all parts of the country the most interesting practical suggestions from enthusiastic motorcycle readers that we have ever seen. While the Mechanical Editor of the POPULAR SCIENCE MONTHLY had anticipated a stirring contest, he was by no means prepared for the scores of striking suggestions which he has received. As a result, he has decided to keep and pay for a far larger number of articles than he had planned. The prize winning article will appear in the next issue of the POPULAR SCIENCE MONTHLY.

The following are the names of the prize winners and the names of those whose articles were considered of such merit that they have been bought:

The Three Grand Prizes were Awarded to:

First Prize of $25—B. M. Ikert—How to Build a Motorcycle Garage.

Second Prize of $15—Edwin C. Schurch—Re-Modeling the Motorcycle.

Third Prize of $10—David W. Freye—Dynamo Lighting System for the Motorcycle.

The following articles that did not win a prize but were of sufficient merit to be used in the Practical Workers department:

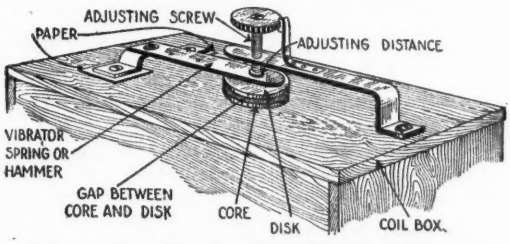
W. G. Paulson—Things to Know About Motorcycle Clutches.
W. A. Jones—Brake for a Belt Drive Tank Pump.
John F. Fetterlt—A Motorcycle Jack.
Paul Justus—Troubles with the Safety Spark Gap.
William H. Smith—A Spark Plug Lock for a Motorcycle.
George Stoneham—A Motorcycle Wind Shield.
W. H. Sargeant—Repairing a Broken Motorcycle Frame.
J. R. Schultz—Repair Link Made of Cotters.
Harold E. Page—Temporary Repair on a Broken Valve Spring.
W. Drynan—Holding Lock on Motorcycle to Prevent Rattle—Sidecar Heater.
Joseph F. Sylvia—Extension Axle for a Sidecar.
Ray E. Stewart—Combination Tandem Seat and Tool Box.
Duncan Dillon—Repairing Gasoline Pipe with Oiled Paper.
Oscar B. Becker—Coin Used to Close Hole of Broken Oil Window.
George Thornton Morris—Detecting Leaks in Inner Tubes with Smoke.
Chas. A. Speer—How to Patch an Aluminum Crankcase.
H. E. Fitzer—Keeping Oil from the V-belt.
Joseph Schmelzeis—Running Home Without a Carburetor.
Roy K. Taylor—Sidecar Wheel Stand.
B. Husmann—Substitute for a Broken Valve Spring.
John E. Hogg—Road Repair for Broken Cones and Bearings—Temporary Repair on a Clutch Pedal Stand.
N. Winderlich—A Valve Tool.
Ernest Ofeldt—Taking Up Wear in Pitman Bearings.
R. W. Jamison—Substitute for a Lost Bronze Bearing.
William F. Bacchus—Repairing Crankshaft.

The Amateur Electrician

And Wireless Operator

Increasing the Spring Tension on Vibrator Adjustments

USUALLY the vibrator of a spark-coil has only one adjustment, and when the parts become worn or the screw fails to do its duty some means must be employed to obtain results. The position of the contact points requires fine adjustment



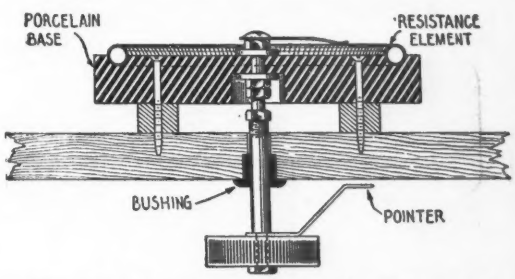
Paper strips placed under edge of spring-supports to secure fine adjustment of the tension

for the coil to deliver sparks of maximum power. The wear may be taken up by the screw but this will cause a weak tension on the spring.

To overcome this difficulty on the coil I owned, pieces of paper were placed under the spring-support as shown in the illustration. This made it possible to obtain a finer adjustment with the thumbscrew, and eliminated the trouble.—JOHN U. LEVERSEE.

A Concealed Rheostat for Audion Cabinets

ON audion cabinets a rheostat is generally used for controlling the low-voltage battery current. The cabinet looks much neater if the rheostat proper is concealed and only a control-handle and pointer can be seen. Such a rheostat may be constructed as follows: Procure a porcelain-base battery rheostat and remove the stiff brass contact-arm and the center bolt. Make a contact-arm from light spring-brass and slip it on a long battery-bolt; lock it in place by means of a flat battery-nut, place on a washer and then insert the bolt in the hole in the center of the rheostat. Place another washer over the bolt, on the back side. The connection with the binding post should be soldered to this washer. Screw on two more flat battery-nuts, adjusting them so that the arm will slide evenly and smoothly over the resistance element, and then lock the nuts by screwing them against each other. Next secure a brass rod ¼ in. in diameter and sufficiently long to project 1 in. from the front of the cabinet when the rheostat is placed against the back of the panel. Such a shaft may be found in some old telephone ringers. Drill a hole in one end of the brass rod and thread the hole to fit the bolt in the center of the rheostat base. Turn the other end down a little in a lathe and thread it so that it will take a battery-nut. Screw a nut on to the bolt on the rheostat and then screw this bolt into the hole in the end of the shaft, locking it by screwing back the nuts. Drill a hole in the panel of the cabinet and insert in this a bushing from an ordinary incandescent-light socket. Insert the shaft and screw the rheostat to the back side of the panel. Make a pointer of brass, about 1½ in. long and slip it over the small threaded end of

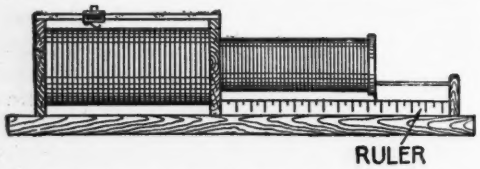


The rheostat is on the back side of the panel and is operated from the knob in the front

the shaft. Make a handle by cutting a piece of hard rubber, or fiber, ¼-in. thick, in the form of a circle 1½ in. in diameter, drill a hole in the center, and place it on the shaft over the pointer.—FRANK SAHLMAN.

Scale for Inductive Coupler for Making Log-Book

PROCURE a wooden ruler and cut it the proper size to fit between the front end of the primary and the support for the secondary rods. Fasten it so that the coupler secondary will clear it, and attach a small pointer to the secondary coil end. This will serve as a guide when tuning for distant stations



An ordinary ruler fastened between primary coil end and support for a scale

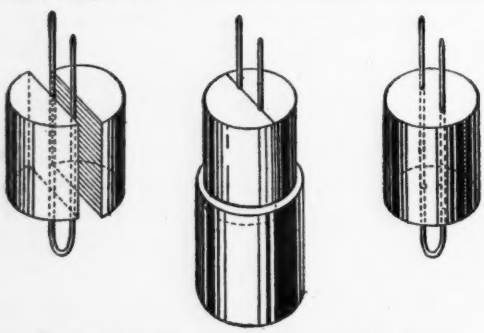
and is also very handy in making out a log-book. Once you have used a scale to mark the coupling of your receiver you will always want one.

Select an ordinary ruler such as found in school outfits, which has graduations no less than 8 to the inch—16 will be much better.—SAMUEL HUFF.

Heated Wire Is Telephone Transmitter

IT is an interesting fact not generally known that an exceedingly fine wire, red hot, will, under suitable conditions, serve as a telephone transmitter. Sound waves striking the wire vary its resistance to such an extent that the variations are plainly noticeable in a sensitive telephone receiver.

A Russian inventor has recently brought out an improved type of "thermo-telephone," as it is called, in which



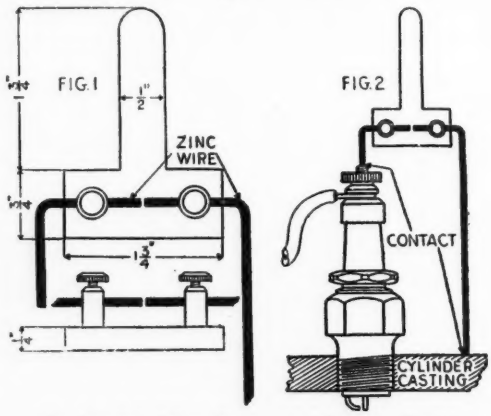
Wire embedded in block of suitable insulating material and used for a transmitter

the heated wire is almost entirely enclosed in a protective body. His invention includes a number of ways of embedding the wire. In one case, it is cast in a block of suitable insulating material. In others, it is merely held tightly between the surfaces of close-fitting hinged plates.

In use, the ends of the heated wire—which is usually Wollaston or very fine platinum—are connected through a battery to the receiver. Sound waves striking the block increase or decrease the resistance of the wire, allowing more or less current to flow through, with a consequent variation of the sound being emitted by the receiver.

Device for Testing Spark-Plugs Without Removing Them

DESIGNED to enable spark-plugs to be tested without unscrewing them from the cylinder, the simple device shown in the accompanying views consists of a T-shaped handle of non-



An insulated handle for making spark gap on an engine plug without unscrewing it

conducting fiber to which are attached two pieces of zinc wire of unequal length. The wires are bent as shown and are held in place on the fiber handle by means of two binding posts, the ends of the wires between the posts being about the thickness of a dime apart.

In operation, the main spark-plug wire is kept in place to furnish current to the plug and the short wire of the device placed on the top of the plug electrode and to the long arm on the cylinder. Then as the motor is turned over, a spark will jump the gap between the ends of the zinc wires if the plug is in good condition. If short-circuited, no spark can be secured. If the porcelain is defective the spark will be weak and irregular.

How to Make an Electric Heater

One of three hundred and twenty-six watts capacity is easily constructed

By Roland Jens

A SMALL electric heater, although slightly more expensive to operate than a wood or coal stove, is ideal for a bedroom, or rooms that are not required to be heated at all times. The heated air from an electric heater is as pure as the air in the room in which it is placed, while if the same room is heated with a coal stove, poisonous gases escape. Details are shown in Fig. 1. The work may be divided into the following parts:

(1) Construction of cylinders.
(2) Construction of legs or base.
(3) Winding of cylinders.
(4) Construction of cover plate.
(5) Assembly.
(6) Connections.

First the sheet iron plates are to be cut. Sheet iron of 1/32 in. thickness should be used, but if this cannot be obtained, plates slightly thicker or thinner will do. Cut the plate for the 12-in. cylinder (Fig. 6). In order to make the corners exactly 90°, lay off a base line on the plate from which you are to cut and with a carpenter's square lay off on the base line two right angles 38¾ in. apart.

Lay off 18 in. on the two lines which form a right angle with the base line. Connect the two points by a straight line, and you will have a rectangular plate. The ¼-in. holes are now drilled or punched. Drilling is preferable as it gives a better and more accurate hole than punching. After the plate for the 12-in. cylinder is done the plates for the other four cylinders are laid out and drilled in the same manner.

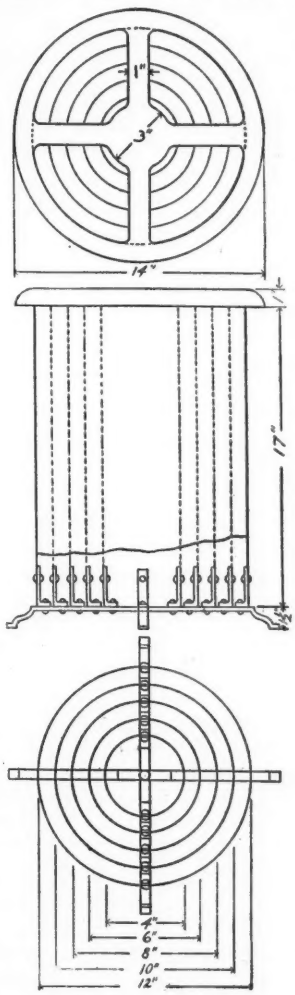
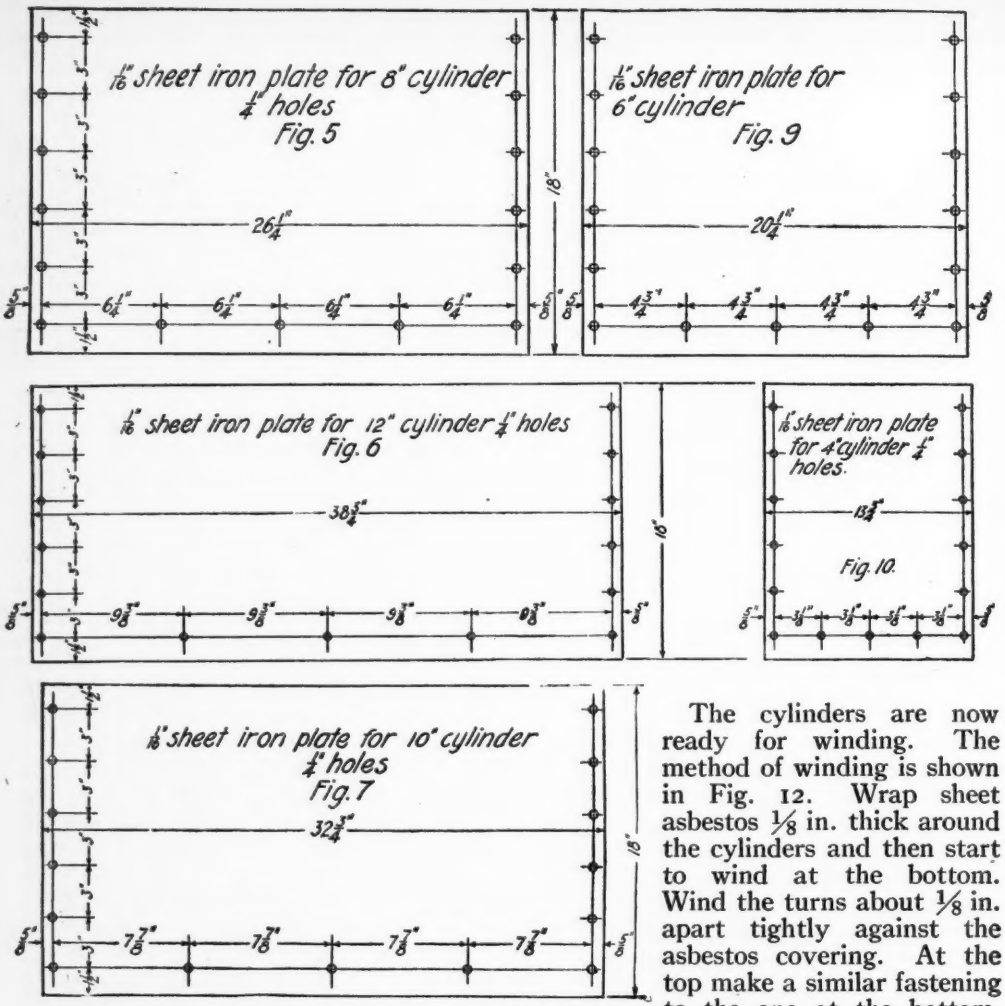


Fig. 1. Top, elevation and base plan of electric heater

The next step is the rolling and riveting of the sheet iron plates. If a roller for rolling sheet iron is at hand this part becomes easy, but if it is not, other means will have to be resorted to. One alternative is to bend the plates over a round wooden cylinder or gas pipe which is of about the same diameter as the cylinder. As the metal is thin, it can be easily bent in this way with reasonable accuracy. After the sheets have been bent, rivet the upper five holes with ¼-in. soft iron rivets 3/16 in. long. The lower hole is not riveted at this time because the cylinder is fastened to the base by means of this rivet. If the cylinders are not quite round, due to improper bending, they may be rounded off by placing them on a fairly large piece of gas pipe and pounding them into shape with a maul.

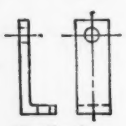
The legs or stand of the heater are made of two strips of sheet iron ⅛ in. thick, 1 in. wide and 17 in. long. (Fig. 11). Center-punch the middle of each piece and lay off the ¼-in. holes, as shown in the drawing. Drill the holes and file off the burrs caused by drilling. To bend the ends into the shape shown, grip the strip and a ¾-in. bolt in a vise and pound the metal until it closes around the bolt the desired distance. Remove the bolt and strip. Turn the strip around, tighten in the vise again with the bolt and pound with a hammer to get the second curvature. Do this to each end and then rivet the two together with a ¼-in. rivet through the center hole.

The next parts to be made are the ¾



Patterns for laying out and marking the drill holes for making the cylinders to hold the heating elements

in. by 2 in. angles by which the cylinders are fastened to the base. (Fig. 8). These angles are made of sheet iron strips 1/16 in. thick and 1 in. wide. Cut twenty pieces of this size sheet iron strips 2¾ in. long and bend them as indicated in the drawing. A good way to do this is to clamp the piece in a vise so that 2 in. protrude above the grips, and pound this part over with a hammer until a right angle is formed. The two ¼-in. holes can then be drilled as indicated.



Cylinder base clips

The next operation is to rivet the angles on the bottom of the cylinders. The angles are riveted on the inside of the cylinder the long side against the side of the cylinder.

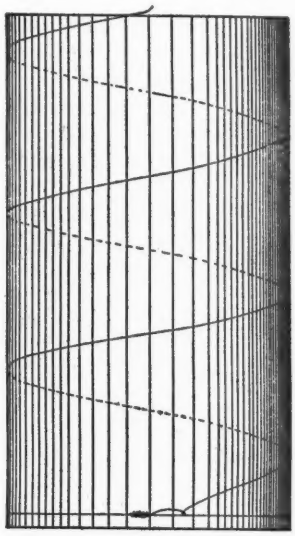
The cylinders are now ready for winding. The method of winding is shown in Fig. 12. Wrap sheet asbestos ⅛ in. thick around the cylinders and then start to wind at the bottom. Wind the turns about ⅛ in. apart tightly against the asbestos covering. At the top make a similar fastening to the one at the bottom. To make the fastening permanent solder the junction. No windings are placed on the 12-in. cylinder, as it is used to protect the windings on the other cylinders. One pound of No. 25 B. & S. gage bare copper wire will be required.

The next part to be made is the cover plate. A detail drawing is shown of it in Figure 1. This plate is made of sheet iron.

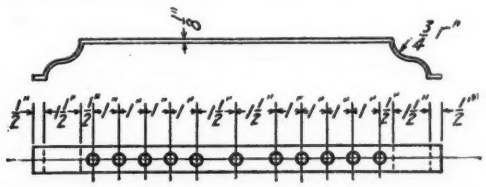
After all parts are finished and the cylinders wound the parts are assembled. Place the 12-in. cylinder in position and rivet it to the base by means of ¼-in. rivets, connecting the angles and the base. After this is in place fasten the 10-in. cylinder in the same way, then the 8-in., 6-in. and 4-in.

The next operation is the making of proper connections. The lower end of

wire of the 10-in. cylinder is connected to one of the terminals. The top end of wire of the 10-in. cylinder is connected to the lower end of wire on the 8-in. cylinder, the connection being made at the bottom. Enough wire has to be left at the top of all cylinders so that this connection can be made. Care must be taken that the wire does not come in contact with any metal at any point. In the same way connect the windings of the 8-in. and 6-in. and of the 6-in. and 4-in. cylinders. The top end of the wire on the 4-in. cylinder is brought out to the other terminal. The two terminals may be placed near the bottom of the 12-in. cylinder. Drill through two ¼-in. holes and insulate two terminal posts in these holes and tighten them. The wires from the heater leading to the terminals can be connected on the inside and from the outside the socket connections can be made. The terminals from the positive pole of ordinary dry batteries can be used. Drill the two ¼-in. holes about 2 in. apart at any convenient place near the bottom. Insulate the terminals with hard rubber or fiber. After this is done place on the cover plate and the heater is ready for use.



A loop is made for starting wire and coil on cylinder



Pattern for cutting and drilling the legs or stand pieces that hold the cylinders

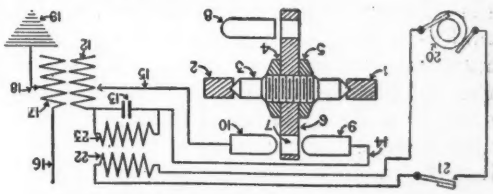
New Patent on Interrupter Spark-Gap

A ROTARY spark-gap, or one upon which a cooling air-blast is blown, is generally more regular in operation than a simple open stationary-electrode device. To secure uniform sparking, the condition of the gap and the electrodes must remain constantly the same. If ionized gas collects between the sparking points, the breakdown voltage of the gap will be reduced and sparks will pass prematurely. The same unfortunate result occurs when the electrodes become overheated and tend to produce arcs. The effect of such irregular sparking is to reduce efficiency and to make production of a clear signal-tone impossible.

The drawing shows a form of spark-gap devised by H. Shoemaker and disclosed in U. S. Patent 1,170,853 for 1916. The usual alternating-current transmitting circuits are used, in which power from the generator 20 is led through key 21 to step-up transformer 22-23. The secondary charges condenser 13, which oscillates through primary 12 with variable top 15 and spark-gap 9, 10.

The antenna 16 and ground 19 are coupled through secondary 17.

The novel feature of this transmitter is that between the stationary gap electrodes 9, 10 is inserted a rotary disk of mica, glass, porcelain or some other such insulator, pivoted on shaft 3 and supported in bearings 1, 2 as shown. At equal distances around the disk, and a few inches from the outer edge, are drilled a series of holes such as indicated at part 7. These holes pass in front of the spark-gap electrodes, and sparks can pass only when a hole is directly between 9, 10. Thus, by rotating the drilled insulating disk the effect of a rotary spark-gap may be had without any difficulties of insulating moving parts. The disk may be driven by an electric motor. The patent suggests making it a sort of air-driven turbine.

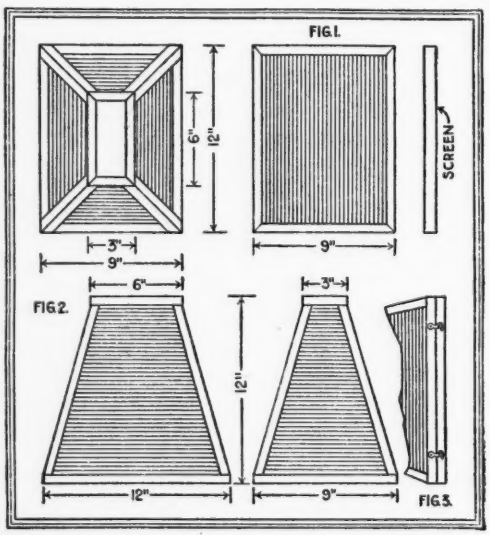


A mica disk with holes is rotated between the gap electrodes, assuring an even spark

Making a Practical Fluoroscope at Home

MANY electrical experimenters possess apparatus such as Tesla, or high frequency apparatus, a large spark-coil, or a static machine, which may be used very well for X-ray experiments with only a few accessories. The high cost of the most important of these accessories, the X-ray tube and the fluoroscope, has caused many amateurs to defer, not without reluctance, work in this most interesting and instructive field.

It is impossible to make an X-ray tube in the ordinary shop or laboratory, but it may now be purchased at a very reasonable price. In order to secure the best results, care should be taken to select a tube designed especially for use with the particular type of apparatus to be used. There is considerable difference in the design of tubes for the different types of apparatus. A tube made for use upon a static machine may give very poor results upon a coil or for other purposes, and last only a short time. It is best to get a tube with some form of vacuum-regulating device, as it greatly increases its usefulness and life.



Frame and pyramid for cutting out the side lights from the fluorescent screen

A fluorescent screen or fluoroscope may be constructed in the laboratory, and may be used equally well with any form of apparatus or tube. To make the fluorescent screen, the fluorescent substance is mounted upon any suitable supporting surface, such as cardboard, in an even continuous layer, so that the rays act through the support and excite the active substance.

A great deal of experimenting has been done in order to ascertain just what substances are fluorescent, and which possess this property in the highest degree. Perhaps the substance best suited for the use of the average experimenter is calcium tungstate. This is sometimes found in a sufficiently pure state for use in the natural mineral scheelite, or it may be purchased from a reliable chemist, or made in the laboratory. Great care should be taken in order to secure a good crystalline variety.

In order to prepare calcium tungstate ($CaWO_4$), in the laboratory, 294 parts, by weight, of sodium tungstate, ($Na_2 WO_4$); 111 parts-of calcium chloride, ($CaCl_2$); and 59 parts of common salt, sodium chloride, (NaCl) are thoroughly mixed. The commercial, chemically pure sodium tungstate should first be pulverized and heated in an air bath to about 110° C. or 225° F. until the water of crystallization has been driven off, and the salt is thoroughly dry. The calcium chloride and salt should also be pulverized and dried at about the same temperature. This should be done before weighing the chemicals.

The mixture is placed in a crucible and heated in a furnace or with a blast lamp until it is thoroughly fused. The crucible is then very gradually cooled, and when cold, the mass is extracted by dissolving out the sodium chloride with water, which leaves a mass of calcium tungstate crystals. These are separated from the liquid by filtering, washed well with water to remove any trace of the chloride, and thoroughly dried. These crystals should be sifted through a sieve with a mesh of about 30 to the linear inch, and preserved for use in a well stoppered bottle.

Another method of preparing this salt is to precipitate the calcium tungstate from a solution of sodium tungstate in water, with calcium chloride or nitrate. The precipitate is removed by filtering, thoroughly washed, dried and mixed with about twice its

bulk of borax (sodium tetraborate, $Na_2 B_4 O_7$). This mixture is placed in a crucible, fused thoroughly, cooled very gradually, and, when cold, dissolved out of the crucible with water. Great care should be taken to obtain the salt in as perfect a crystalline form as possible, for its fluorescence appears to be very much dependent upon this.

A piece of good grade, smooth, lightweight cardboard, 12 in. long by 9 in. wide, is covered with a layer of glue, made by dissolving gum arabic in water. Care should be taken to have the glue in a very even layer. The calcium tungstate is sifted onto this from a sieve in as even a layer as possible, not too thickly, yet covering all parts well. This is called the fluorescent screen.

A light, square frame, as shown in Fig. 1, of the same size, 9 in. by 12 in., should be made from soft wood about ½ in. wide by ⅜ in. thick. The fluorescent screen should be tacked or glued to the one side of this frame, with the coated side next to the wood, as shown.

Another frame, as shown in Fig. 2, shaped like the frustum of a pyramid the lower base of which is 9 in. by 12 in. (the same size as the frame supporting the fluorescent screen), the upper base 3 in. by 6 in., and the altitude 12 in., is made from wood ½ in. wide by ⅜ in. thick. The sides of the frame should be covered with black velvet or other dark colored cloth, so that it will entirely cut off the outside light. This covering should extend about 2 in. or 3 in. over the small end of the frame, so as to form a curtain about the face when looking into the frame. This frame serves to cut off the outside light when looking at the fluorescent screen, and may be provided with a handle to facilitate handling. It should be provided with flat springs or hooks, as shown in Fig. 3, on the larger end, so as to hold the smaller frame supporting the screen in place. The coated side of the screen is placed inside.

In case it is desired to experiment further, a number of substances will be found which fluoresce under the action of the X-rays. Most of the phosphides of the alkaline earths and the salts of manganese, cadmium, strontium and lithium, are active. Liquids are generally inactive, and it is noted that while quinine sulphate give a bluish glow, a solution of this sulphate is only very slightly excited.

Thomas A. Edison experimented with some 1,800 phosphorescent and fluorescent substances, some of which are here given: Ammonium platinocyanide, ammonium salicylate, barium sulphate, boracic acid, cadmic iodide, calcium fluoride, calcium platinocyanide, calcium sulphate, calcium sulphide, corundum, curcumin, caturine, glass, mica, mercurous chloride, obsidian, pentadecyltolyl-ketone, potassium acetate, potassium iodide, potassium bromide, potassium platinocyanide, quinine salts, rock salt, strontium platinocyanide, strontium sulphate, strontium sulphide, strontium tungstate, uranium fluoride, and uranium sulphate. A few of these substances are active under the rays of a Geissler tube.

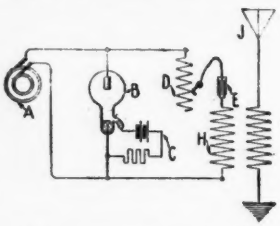
The substances most used on commercial fluoroscopes are calcium tungstate and barium platinocyanide. Uranium ammonia-fluoride gives good results also. Some experimenters claim better results with barium platinocyanide than with calcium tungstate, but this depends somewhat upon the crystalline condition of the salts. However, the high cost of barium platinocyanide more than offsets this possible advantage with the average amateur experimenter. In mounting barium platinocyanide, uranium ammonio-fluoride or substances soluble in water on the screen, a solution of celluloid in amyl acetate should be used, so as not to injure the crystalline form of the active material.—CHARLES E. MILLER.

Cutting Holes in Plaster for Switch-Boxes

CUTTING a hole in plaster for the purpose of locating an electric switch-box is a difficult and untidy task and especially where this is to be done on a completed house. The job can be accomplished quickly and neatly if a box is used for the cutting. A box of the proper size, set with its edges to the plaster and driven on the bottom, will cut a neat square or rectangular hole without much effort. Begin by driving on one corner and follow along one side and then around the box. The edge will cut the plaster through and the particles loosened will fall into the box.

Increasing the Frequency in Radio-Telegraphy

THE simplest way to set up currents of very high frequency in a wireless telegraph antenna is to connect a special radio-frequency alternator in series with it and the ground. If this special dynamo generates current of 100,000 cycles per second, and if the antenna system is tuned to this frequency, intense waves of 3,000 meter wavelength will be radiated. It is a very difficult mechanical problem to design, build and operate alternating current dynamos of large power at such high frequencies as 100,000 per second. Such machines are in use, however, giving outputs of some five kilowatts, and it is believed that much larger generators of the same sort can be built. But it is much easier to make dynamos of lower frequency. If a 33,300 cycle generator is connected to an apparatus which triples the current frequency, it is evident that the output terminals of this frequency transformer could be led to an antenna circuit and that the system would set up, in the antenna, currents of 100,000 cycles per second frequency. By using a large alternating current dynamo of one-third the frequency its construction is greatly simplified; and as a result of this fact, inventors have for some time striven to produce efficient frequency transformers to be used in radio transmitters.



An unusually simple method for greatly multiplying the normal frequency of an alternator

United States patent number 1,174,493, recently issued to E. F. W. Alexanderson, shows how a mercury-vapor tube may be used to distort the wave-form of a high frequency alternator and how the augmented harmonics may be picked out and used to excite antennas for wireless. The figure is taken from the patent, and in it *A* represents the high frequency machine which supplies power to the system. Connected across its terminals is the mercury-vapor bulb *B*, which may consist of a vessel having two pools of mercury at its bottom and a third electrode at the top, as shown. An electric arc passing between the pools and fed with current from the auxiliary circuit *C*, comprising a battery and resistance, serves to start the vacuum tube; current from the dynamo *A* keeps it in operation thereafter.

The effect of using such a vapor lamp as a load for the alternator is to emphasize the third and even the higher odd harmonics in the fundamental current; that is to say, when the lamp is lighted the generator is caused to amplify one of these harmonics which are always part of the entire current it gives out. Each of these component currents in an ordinary generator is a direct odd multiple of the original frequency, so that if the dynamo is built to generate 30,000 cycles, the generator-and-lamp system will produce principally currents of 90,000 cycles, or even higher frequencies.

Series circuits containing capacity and inductance, such as *D*, *E*, and *H*, may be connected across the line wires and "tuned" to the high harmonic frequencies. When this is done, comparatively large currents of the tuned frequency will be produced in each condenser and coil. A transformer primary, such as *H*, being part of the same circuit, is coupled to an antenna and ground system, as indicated at *J*.

If the antenna is also tuned to the harmonic frequency, it will have set up in it currents of that frequency and will radiate corresponding waves. Thus a comparatively low-frequency dynamo may be used to generate very short waves by this process of frequency transformation. If the fundamental frequency is 25,000 per second, the wavelength produced directly would be 12,000 meters; by tuning the circuit *D*, *E*, *H* to the third harmonic, and adjusting the antenna to correspond, waves only 4,000 meters long are sent out.

Specially constructed alternators giving unsymmetrical currents are now being used with this system of amplification also. Only unsymmetrical waves may contain the even harmonics, so that the system can be used with such an alternator simply to emphasize the second harmonic, thereby doubling the frequency.

An Emergency Aerial Using Door-Bell Wires.

HAVING some difficulty in getting an aerial erected, I tried using one side of the wires connected with the door-bell. With this indoor antenna I am obtaining very good results in receiving. It is only necessary to disconnect one of the bell wires and attach a wire to lead to connection on the tuner.—RICHARD A. LIDDANE.

How to Become a Wireless Operator

VII.—The Variable Condenser for Tuning the Secondary

By T. M. Lewis

THE direct coupled receiving tuner which was described in detail last month will prove satisfactory for long distance working, up to the limit fixed by the sensitiveness of the detector and telephones used in connection with it. The loudness of signals, if the coils and switches are properly built, should compare very favorably with the best obtainable by using an inductively coupled receiving transformer of equivalent design. To get the strongest signals, in either the direct or the inductively coupled outfit, the operator must determine by trial the best settings of primary and secondary inductance and coupling, as previously pointed out.

Sharpness of Tuning

Although the simple tuners without variable condenser in the secondary will give loud signals, and in fact about as loud as can be obtained by any arrangement of tuning circuits when working with spark stations, the best sharpness of tuning cannot be secured. When two transmitters are heard at about the same intensity and on only slightly different wavelengths, it is difficult to build up the signals of either at will by the mere adjustment of the coupling and primary and secondary inductances, when the circuit without variable condenser is used. For this reason the tuner, whether inductively or conductively coupled, which has the detector directly in series with the blocking condenser (*i. e.*, which has no condenser directly across the secondary terminals for tuning) is called "broad tuned." However, if a variable condenser is connected as shown in Fig. 1 and 2, the selective powers of the circuit become very much greater and it is called "sharp tuned."

The details of adjustment which are necessary in order to get the best results from the sharply tuned receiver will be taken up in full next month. The manipulation of this receiver should be second nature to all radio operators, since it is the arrangement of apparatus used by the great commercial companies. In the hands of an unskilled operator better results are sometimes obtained with simpler circuit arrangements; the reason for this is simply that the man does not know how to get the most out of the sharply tuned lay-out. The circuits of Fig. 1 and 2, when correctly adjusted, provide the maximum selectiveness which is to be had in the best commercial receivers in general use. Securing the correct adjustment, once the principles are clearly understood, is merely a matter of practice. It is essential for the student, therefore, to familiarize himself with the actions of such receivers under all conditions likely to be encountered in practice.

The Variable Condenser

Since Fig. 1 is exactly the same as Fig. 7 of last month's article, except for the addition of the variable condenser and a single pole switch for cutting it out of circuit, all of the instruments described in the preceding articles of this series may be utilized. The switch of Fig. 1 is preferably a small single pole, single throw knife-switch, since this type almost invariably gives good contact, though any other form will be satisfactory if kept in good condition. The variable condenser is the important new instrument, and must be of good design if it is to be really useful. The amateur who has sufficient funds at his disposal will do well to buy one of the standard variable condensers now on the market; if he sticks to the ordinary semi-circular rotary type, having a capacity of about .001 microfarad and costing from $5.00 to $25.00, he will be likely to get a good instrument for tuning. The cheapest apparatus, as well as the various freak forms

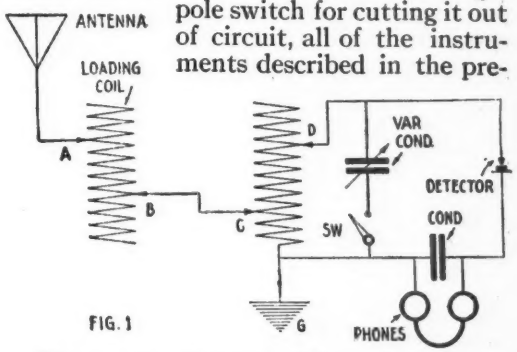


Diagram for direct coupled receiver with variable condenser and a single pole switch

which appear from time to time, are less likely to be satisfactory.

Since good variable condensers are expensive, as compared with the other parts of short-wave receiving apparatus, a simple and yet good design for making them at home will be described. The condenser made in this manner will prove rugged and suitable for continuous operation, will have good insulation between its terminals, and yet will be found easy and comparatively quick to build.

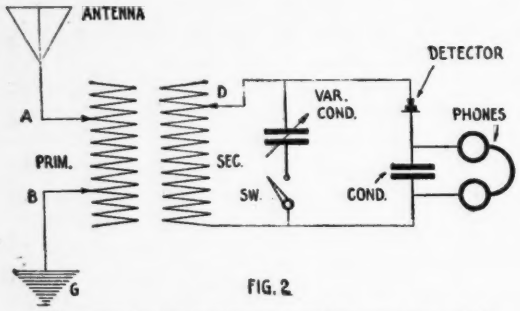


FIG. 2

Diagram for inductively coupled receiver with variable condenser and single pole switch

The Fixed and Moving Plates

The plates of the condenser may be made of almost any conducting material. Aluminum about 1/32 in. in thickness is by far the best, since it is light, soft and easily kept flat. Soft brass or copper will prove suitable though heavy, and even sheet tin can be used if reducing the expense is of the greatest importance. The fixed plates are laid out as shown in Fig. 3. They consist merely of rectangles 2 by 5 in. in size. About ⅜ in. from each corner, on a 45 deg. line a hole is drilled to take the supporting uprights. The relation of the plates to a semi-circle of 2 in. radius, which corresponds to the active surface of the moving plates, is also shown in Fig. 3. The rectangular form of plate is shown for the reason that it is the quickest and easiest to cut out. Obviously, if material is of more importance than time, the corners may be cut off and the outer side of the plate held by a single vertical bolt passing through suitably placed holes at or near the center of the upper edge.

The form of the moving plates is shown in Fig. 4. Essentially, these are portions of circles having a 2-in. radius; they are roughly semi-circular in form, and the exact relation to a half-circle is shown by the dotted lines. A hole to take a 5/32-in. bolt is drilled at the central point where the radii meet, as shown. This design of plate is about the easiest to make of all that have been suggested, and yet is not particularly wasteful of material.

For the tuning condenser, 13 fixed and 12 movable plates may be cut out. The simplest way is to make a full size templet or pattern out of pressboard, and to scratch the outline of each plate on the material by running a needle around the edge of the pattern when held tightly on the surface of the metal sheet. The plates are then trimmed out with sharp shears, clamped together in a vise and filed to exactly the same size and shape. They must be flattened by hammering, preferably between perfectly flat metal surfaces, until no dents or warping can be seen when the plate is held edgewise to the eye.

The Top and Base

Hard rubber or horn fiber, from ¼ to ⅜ in. in thickness is the best material for the top and base. If these cannot be used, hardwood about ½ in. thick will do. In the illustration, Fig. 5, are shown the two pieces that form a 5-in. square, and how they are drilled at each corner, in the center, and at the inner corners of the fixed plates, to take the several bolts. The base must also be drilled and tapped near the center, to take the foot or base bearing of the vertical shaft, to be described later. In Fig. 5 there are shown the outlines of both the fixed and moving plates in their proper relative positions, so that no difficulty should be experienced in laying out the holes once the plates have been finished.

Other Materials

Practically nothing else is needed except a number of 8-32-hexagon brass nuts (machine screw size No. 8 with 32 threads per inch), a considerable quantity of copper washers or burrs which will slip freely (but not too loosely) over an 8-32-machine screw, six threaded brass rods of 8-32 size and about 5 in. long (the excess is cut off after assembly), a 5 in. by 5/32 in. threaded

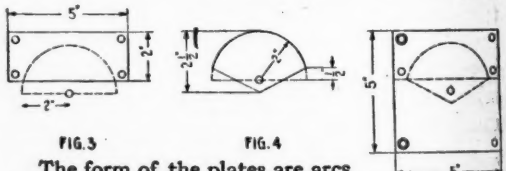


FIG. 3 FIG. 4 FIG. 5

The form of the plates are arcs of circles having a 2-in. radius

brass rod with 6 hexagon brass nuts to fit, a number of perfectly flat brass or copper washers of about 5/8 in. outside diameter, which will slip over the 5/32-in. bolt, a little soft brass strip, two small screws and a hand wheel. In Fig. 6 is shown how one of the 8-32 bolts is used to support the top of each corner of the group of fixed plates in proper relation to the top of the condenser itself. As indicated, the completed assembly begins at the top with a hexagon nut and washer, after which comes the 5-in. square top plate. This is clamped in place by means of a second washer and nut, after which come separating washers to space the uppermost fixed plate the proper distance from the lower side of the insulating top, and then that plate itself. After the first plate, enough washers to make a space of 1/4 in. are put on the threaded rod, and then the next plate. Thus the thirteen fixed plates are placed on and clamped by the nuts of four of the threaded rods. At the bottom, as shown in Fig. 7, the third nut is screwed upward to hold the plates firmly, and a fourth nut turned on to the point which will hold the lowest fixed plate the correct distance from the upper side of the insulating base. After adding a washer, the base itself is placed on, and then a threaded rubber, wood or fiber foot is screwed on to clamp it all in place. Of course, only the corner posts of the base itself take these feet; the two rods at the inner edges of the fixed plates are fastened by screws and washers on the lower side of the base.

The two corners of the base, shown at the lower part of Fig. 5, where no fixed plates reach, are supported by the fifth and sixth threaded 8-32-rods in the manner shown in Fig. 6 and 7, with the obvious exception that the plates themselves and their separating washers are omitted.

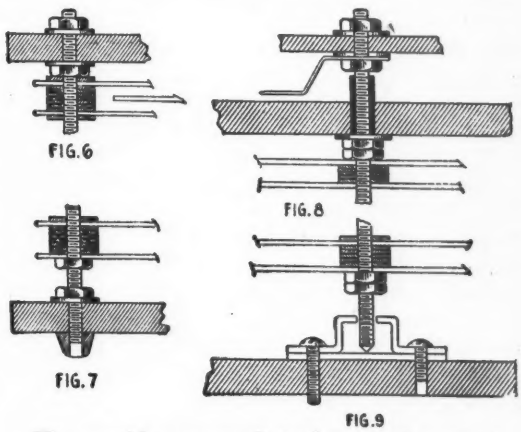
The Rotary Part

The moving plates are assembled upon the 5/32-in. threaded rod, clamped by the hexagon nuts and separated by the larger washers, as shown in Fig. 8 and 9. Beginning at the top of Fig. 8, it is seen that the hand-wheel, which may be a knurled disk of 1/4-in. hard rubber 2 in. in diameter, is clamped at the top of the 5/32-in. rod or shaft between two washers and nuts. Between the lower nut and washer there is gripped the end of a bent metal indicator-hand, which points to a degree scale (a cheap protractor makes a good one) mounted on the upper side of the insulating top. Just below this lower nut is a little brass bushing or tube, forced into the insulating top and having the right inside diameter to act as a bearing for the shaft. Below this come separating washers—one or more—and then two nuts which lock each other and hold the moving plates in place. The uppermost moving or semi-circular plate comes next; immediately below it, and separating it from the next plate, are enough of the larger washers to space the plates just 1/4 in. apart.

As shown in Fig. 9, the moving section is built downward, and the lowest plate is clamped in place by two more nuts. The shaft itself continues for about 1/2 in. farther, and is tapered off to a blunt point so as to reduce friction.

The Lower Bearing

In Fig. 9 is also shown how two pieces of 1/16-in. soft brass strip are bent and



The machine screw fastening at the upper and lower corners and the main shaft bearings

drilled to form a thrust bearing for the lower end of the shaft. They are secured to the base or lower 5-in. square insulating plate by the two machine screws. Electrical connection is made to the moving plates by soldering a wire to one of these screws, running it out to one of the corner screws which is not associated with the fixed plates, and once more soldering it there. A binding post takes the place of the top nut of Fig. 6 on this outside screw. Similarly, a second binding post substituted for the uppermost nut on one of the screws supporting the fixed plates provides a convenient means of connection with the fixed plates.

For continued service it will not do to

depend upon the electrical contact in the bearing of Fig. 9 alone; a small piece of thin spring wire (brass or phosphor bronze) should have one end soldered to the shaft just above the upper plate of the base bearing, its other end being fastened to the bearing itself after one or two spiral turns are made loosely about the shaft. This will prevent any possible trouble from oxidation of the contacts within the condenser. A stop should be provided to keep the plates from turning more than 180 deg. and twisting off the spring wire.

Assembling and Adjusting

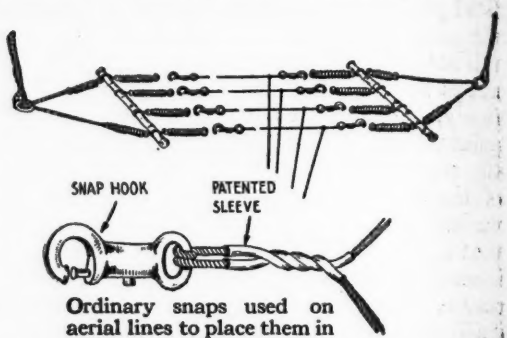
Manifestly the foregoing descriptions, with reference to Fig. 6, 7, 8 and 9, apply to the completed apparatus. The best way to assemble the instrument is to clamp together the fixed plates on their four rods, independent of either the base or top plates of insulating material. When the conducting plates are all set parallel and with the proper ¼-in. spacing, they are laid aside and the moving plates similarly assembled upon the shaft. The base, hand wheel and top are left apart until the moving plates have been correctly spaced and adjusted. Then the moving plates are slipped interleafwise between the fixed plates, and the insulating top put in place. By trial the proper number of washers and the best position of the clamping nuts is determined, and the top is then fastened. Next the base is adjusted to the proper position, and all the fastening nuts tightened. Last of all the hand-wheel and pointer are added, and the scale set to the correct position. It is a good plan to cut a strip of celluloid film to just the width of the space between the insulating top and base, and to bend it around the metal parts so as to exclude dust. When this is to be done, the top and base may be made 5½ in. square to give a little additional edge-space in which the celluloid strip may be fastened by gluing bits of ⅛-in. felt next to it.

The next article of this series will describe fully the use of the variable condenser in the sharp-tuned secondary, as well as methods of adjusting the primary circuit by using the same instrument.

An Easily Erected Antenna for Wireless Operators

ABOARD ships it is necessary to replace aerial wires at least once a year on account of the action of the salt spray and the smoke and gases from the stack. In constructing an aerial it is usual to secure spreaders the proper distance apart and stretch the wires between. This necessitates the removal of the spreaders and their holders from the ship to the wharf or clear space where the work can be done, and often requires the labor of from two to four men for at least one day, depending, of course, upon the size of the aerial. To hoist the new aerial into place requires another half day, with additional men to assist in clearing the wires from davits, funnels, etc.

The aerial aboard a government vessel had to be renewed recently under a guaranty that the vessel would not be laid up; that the radio apparatus would not be kept out of operating condition for more than one hour, and that the same spreaders and attachments would be used. The procedure to meet these conditions was as



Ordinary snaps used on aerial lines to place them in position quickly on a vessel

follows: The phosphor-bronze antenna wire was measured off into the required lengths and a snap hook was fastened to each end. Inasmuch as heat applied in soldering this kind of wire invariably weakens it and makes it liable to part under strain at the point where the heat was applied, soldering the joints was dispensed with and patented sleeves or connectors were used. This allowed also greater speed in the construction.

When all the wire work was complete the old aerial was lowered to the deck and the wires quickly cut away. The new aerial was snapped into place and hoisted aloft. The actual time required in making the change was less than one hour, and the services of three men were required to hoist it in place. The making up of the wires, hooks, etc., can be done by one man, and by using this method an aerial can be installed in one-fourth the time and with only one-third to one-half the labor required by the old method.—FRANK M. MEALS.

A New Mercury Interrupter for Spark Coils

THE distinctive feature of the break described below is its independence from the coil, the cooling of the mercury and the contact pieces and the use of water instead of magnetism to generate the impulses or vibrations. The drawings show the principle of the interrupter.

A glass tube *A* is closed at both ends by the stopper *B*, which supports a hard rubber tube *C* and a glass tube *F*.

A portion of the hard rubber tube *C* has been cut away as shown in the sketch and the end of the tube is closed by the plug *K*.

A blade or tongue *E* is fastened to *C* by means of a clip *D* and fits over the opening of the part that has been cut away. This tongue is made from thin sheet steel and carries at the end a contact-piece *H* which is set close to the mercury *G* contained at the bottom in the outer glass tube *A*.

If now *C* is connected to the water main by means of some rubber tubing, the water-pressure will vibrate the tongue *E* and the contact-piece *H* will be alternately dipped into the mercury and lifted out of it, thus closing and opening the primary circuit of the spark-coil.

After the water has passed the tongue *E* it accumulates over the mercury till it reaches the glass tube *F* by which it is drained away. The water passing over the mercury cools it and also the contact-piece *H* and keeps both in a clean state, which insures sharp interruptions.

The break shown in the general arrangement is mounted in a sloping position, so as to use as little mercury as possible.

To make the interrupter, procure first a glass tube 2 in. in diameter by 9 in. long. Have it cut to the right length in the store where you buy it, as it is very difficult to make a neat job of it and you may break the tube in the attempt. Next procure 2 soft rubber stoppers to fit the tube and see that these stoppers are a water-tight fit. Bore a hole in each stopper to admit the tubes *C* and *F*. Next take the tube *C* in hand. This is a hard rubber tube, ½-in. bore by 6½ in. long. A portion 3 in. long must be cut away as shown in the detail drawing. The easiest way of doing this is to cut to the depth required 3 in. from one end with a fretsaw, and then to file the tube down till the distance from the center of the tube to the cut-away part is ⅛ in. Next fit a cork stopper *K*, ½ in. in diameter and ½ in. long into the end of the tube *C* that has been cut away, and cut off the projecting part.

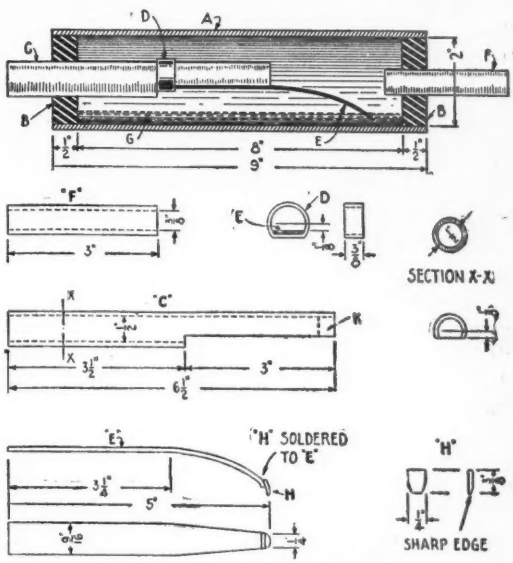
The tongue *E* is now cut from thin springy steel to the dimensions given in detail drawing. A small copper-strip *H* is finally soldered to *E* and bent so as to be at right angles to the mercury level.

The clip *D* is made from thin sheet steel and fitted around the cut-away part of *C*.

The tongue *E* is next soldered to the *inside* of *D* so that the tongue is lying flat against the tube in the entire length of the cut-away part.

Tongue and clip are now given 2 coats of good shellac varnish, but the contact-piece *H* must be left free from varnish.

To assemble the interrupter put the 2



The parts of the interrupter which is operated by means of a flow of water instead of magnets

tubes *C* and *F* in position. After having soldered a No. 12 gage copper wire to the top of the clip *E*, this wire is carried through *B*, as is also a second wire that makes contact with the mercury. Next pour some mercury into the glass tube *A* and bend *E* so that *H* is about 1/32 in. above the mercury level.

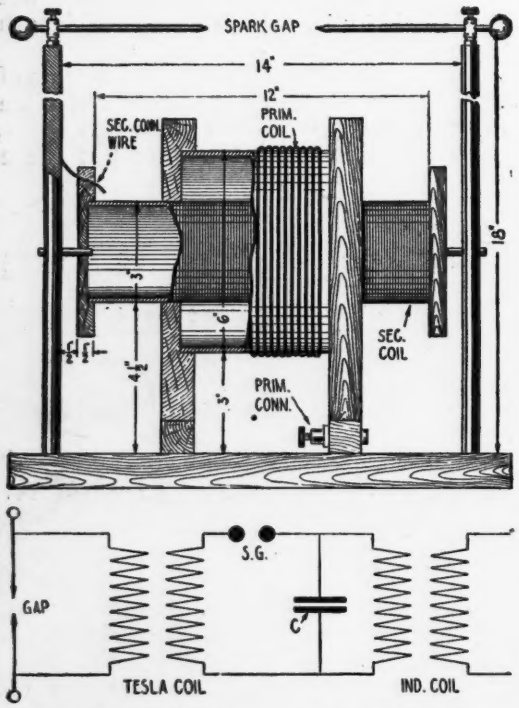
The tube is then mounted on a board by means of 2 small clips.

The 2 wires from *D* and *G* are connected to two binding posts mounted on the board.

To regulate the number of vibrations per second, slip an adjustable pinchcock over the rubber tube from the water-main to tube *C*, and use this as a means of governing the flow of water.

High Frequency Tesla Coil for Electrical Experimenters

ANY one who owns a wireless equipment has the apparatus necessary to operate this coil. It should give at least a 6-in. spark under favorable conditions. The drawing gives the necessary dimensions and shows parts cut away, in order to make the construction clearer. The only apparatus necessary is a spark-gap, an induction coil or transformer and plate-condenser.



Detail of the high frequency coil and the diagram showing how to connect the apparatus

The primary winding consists of 22 turns of No. 14 rubber-covered copper wire wound on a fiber tube, 6 in. outside diameter, and of a length that will hold the 22 turns of wire. The secondary coil is made up of one layer of No. 34 double silk-covered wire, wound on a tube 3 in. outside diameter and 12 in. long. The tall posts carrying the high potential spark-gap should be at least 18 in. high. Fasten the parts together with glue, and do not use any nails or screws except for fastening parts to the base. Finish all over with two or three good coats of thin shellac, drying well between coats.

It is well known that a spark drawn from a coil of this type is not dangerous and only a slight burning sensation is experienced when it passes to the body. Sparks may be drawn from any part of the body without discomfort to the operator, but to the astonishment of the onlookers. This coil may be used quite satisfactorily for entertainments or for various high-frequency experiments. The diagram shows how to connect the apparatus.

Testing Wires and Battery Terminals for Polarity with Litmus Paper

POLARITY indicators are expensive instruments and the testing of a few wires would not warrant the purchase of one. One simple test method utilizes litmus paper. Procure from a local drug store some red litmus paper and thoroughly soak it in a solution made up of one tablespoonful of salt to a glass of water. When it is thoroughly soaked remove the paper carefully so as not to tear it, and hang up to dry where nothing will touch it except the hangers. Never dry it between blotters.

These test papers are used as follows: Take a piece of the paper about 1½ in. long by ½ in. wide and slightly moisten it and place the ends of the wire to be tested on the paper so that they will be about ¾ in. apart. A deep red spot will appear on the paper at the end of one of the wires and a blue spot at the other. The red designates the positive and the blue the negative. Sometimes the red spot will not show owing to the low potential difference between the wires, but the blue will always appear, designating the negative wire.

There are two kinds of litmus paper, red and blue. If the red cannot be obtained get the blue, but the potential difference between the wires will make the red show up more in this instance. After using this paper it can be dried as when taken from the salt solution, and used again.

The Editor of the POPULAR SCIENCE MONTHLY is always glad to hear from readers who have made simple and useful things for the home and the shop with their own hands and who would like to tell others of their own success. Articles from amateur mechanics, electricians and wireless operators are paid for on acceptance, promptly and liberally. But contributors must understand that only unpublished contributions offered exclusively to the POPULAR SCIENCE MONTHLY, are desired.